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# THE THEORY AND PRACTICE
# OF MASSAGE
# AND MEDICAL GYMNASTICS

# THE THEORY AND PRACTICE OF MASSAGE AND MEDICAL GYMNASTICS

BY

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HONORARY FELLOW OF THE CHARTERED SOCIETY OF PHYSIOTHERAPY.
FORMERLY EXAMINER TO THE CHARTERED SOCIETY AND TEACHER OF MASSAGE AND REMEDIAL EXERCISES TO THE NURSING STAFF OF THE LONDON HOSPITAL

SEVENTH EDITION

WITH 147 ILLUSTRATIONS

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A little knowledge is a dangerous thing—not if you know how little it is.—*Sir William Gull.*

IN

MEMORY OF A PHYSICIAN

A FAITHFUL SERVANT OF GOD

A DEVOTED STUDENT OF HIS WORKS

AN EXAMPLE TO HER AND COUNTLESS OTHERS

OF SYMPATHY PATIENCE

AND UNSELFISHNESS

THIS IS DEDICATED

BY A GRATEFUL DAUGHTER

# PREFACE TO THE SEVENTH EDITION

SINCE the last edition of this book was published the term " Physiotherapy " has come into general use. Physical methods used to restore sick and injured persons have been gradually extended and the title now adopted embraces them all, viz : Massage, Exercises, Electricity, Light, Heat, and Hydrotherapy. These are all mentioned in various places, but the volume still deals only with the technique and application of Massage and Medical Gymnastic Exercises. The title therefore remains unchanged but the term " Physiotherapist largely replaces " Masseuse " and " Masseur " in the text, for the name has been universally adopted.

Physiotherapy has gone forward in ways unthought of when the first edition of this book appeared. The present revision therefore has not been a simple matter, but changes have been made with the object of bringing all sections up to date.

The early chapters on massage remain the same and the importance of good work in this branch cannot be overestimated.

The pages dealing with the re-education of muscles have been increased and more detail given.

There are changes in the arrangement of exercises. These now appear according to the " Basic Index," recently drawn up by a committee of recognised teachers and sanctioned by the Council of the Chartered Society of Physiotherapy.

A chapter on Ward Exercises has been added for the use of those who are called upon to instruct patients while they remain in bed.

There are a few alterations in the orthopædic section and the chapter on the physical treatment of respiratory diseases is much augmented, the teaching of correct breathing being now considered important in most chest conditions.

The section on war injuries has been replaced by a brief account of Re-habilitation, a subject, however, so extensive that it cannot be dealt with fully here.

The chapter dealing with physical treatment before and after childbirth has been revised.

The writer gratefully acknowledges a photograph of a Hallux Valgus from Mr. J. Cholmeley, F.R.C.S. Ten X-rays of fractures from the Worthing Hospital, and one from the Derbyshire Royal Infirmary; also other illustrations in the orthopædic section from the London County Council. She also thanks Miss Reed and Miss Linton for photographs in the chapter dealing with respiratory conditions.

New photographs have replaced older ones in the exercise section, Miss Noreen White, and Miss C. W. Morrison being models for these. Their help given in this respect has been greatly appreciated.

Thanks are also due to many friends of the Chartered Society who have given suggestions for this new edition. They include Miss Jocelyn Reed, Mrs. Guthrie-Smith, M.B.E., Mrs. Heardman, Miss Angove, Miss Spicer, Miss Ward, Miss Morris, Miss Cozens-Walker, Miss Sutton and Miss Hay.

Thanks are also due to the Council of the Chartered Society of Physiotherapy for permission to again reproduce specimens of recent examination papers.

With the revisions now made it is the writer's earnest hope that this book will still be of value to the students who scan its pages.

BEATRICE M. GOODALL-COPESTAKE.

*March*, 1949.

# PREFACE TO THE FIRST EDITION

THE increasing number of students who are qualifying themselves for a professional career in the important branch of work of which this book treats, and the Author's experience of their needs, have encouraged her to attempt to place before them in a concise form a résumé of the different branches of the science and practice of massage, access to which she has found difficult to obtain without consulting a mass of volumes not readily within reach.

That the work before them is important and of a national character needs no emphasis at this date; for the basis of it is to restore to usefulness and new opportunities of service men, women, and children who are disabled in varying degrees and from various causes.

Never has the need for their patient study and skill been so great as at the present time, and these pages are published in the earnest hope that they may be helpful to those who are qualifying themselves to take their part in this work.

Theoretical instruction is necessary: but the practical application of their art can only be acquired by perseverance and patience under a good teacher. The manipulations and exercises described are based on Ling's Swedish System; the further details of the application of massage in connection with various diseases and deformities have been added in the hope that they will guide students to an intelligent grasp of their special work.

I gladly avail myself of this opportunity to thank Miss E. M. Magill, M.B., B.S., for many useful suggestions and for reading the proofs; Mr. A. R. F. Evershed, M.R.C.S., for the photographs of massage manipulations which he has taken specially for this book; and Captain Frank Acland for much valuable help in correcting the letterpress.

To the following who have kindly lent original photographs, or have given permission for the use of illustrations from their books, and to their respective publishers, I offer my grateful thanks: Sir William Bennett, K.C.V.O., F.R.C.S.; Messrs. J. Jackson Clarke, F.R.C.S.; J. Russell Howard, F.R.C.S.; A. S. Blundell Bankart, F.R.C.S.; Stanley Melville, M.D.; C. H. Golding Bird, F.R.C.S.; and Messrs. Baillière, Tindall & Cox for illustrations produced from Rose and Carless's *Manual of Surgery*. My thanks are also due to the Incorporated Society of Trained Masseuses for permission to give specimen examination questions, and not least to Messrs. H. K. Lewis & Co. Ltd., for their care and assistance.

BEATRICE M. G.-COPESTAKE.

*October*, 1917.

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# MASSAGE AND MEDICAL GYMNASTICS

## *PART I*

## CHAPTER I

THE HISTORY OF MASSAGE :—Derivation of the word—Gymnastics and Massage among the ancient Chinese, Greeks, and Romans—The writings of Hippocrates—The Emperor Hadrian—Massage in the Middle Ages—Peter Henry Ling—Massage and Exercises in England—Founding of the Incorporated Society of Trained Masseuses—The Chartered Society of Massage and Medical Gymnastics—The Chartered Society of Physiotherapy—Its Aims—Its Rules.

SCIENTIFIC Massage and Medical Gymnastic Exercises have only become popular therapeutic agents in comparatively recent times. In a primitive form, however, they are very old. Massage is probably as old as civilisation itself. To-day manipulations and exercises form a branch of physical medicine, or physiotherapy, and they are used in the treatment of disease, injury, and deformity in many parts of the world.

The word " massage " is probably derived from the Arabic *mass* or *mas'h*—" to press softly " ; though some authorities have attributed its origin to the Greek word *massein* " to knead." In its present form we have it from the French *masser*—" to shampoo."

The use of various manipulations and movements can be traced down the ages for many centuries. Three thousand years before the Christian era, the Chinese had a system of gymnastics and massage, records of which are found in the ancient writings of Kong Fu. It is also mentioned in the sacred books of the Hindus, and the ancient Japanese, Persians and Egyptians all practised massage in some way. Among the ancient Greeks and Romans massage was in an advanced stage of development. Homer, about the year 1000 B.C., tells us in the Odyssey that beautiful women rubbed and anointed war-worn heroes to rest and refresh them.

The Greeks used gymnastics to develop the body, finding such practices an aid to health and causing improvement in mental culture. They had a regular system, combining baths, gymnastics, massage, and exposure to air and sunshine. Eventually there arose a school of gymnast physicians who used these means as therapeutic remedies.

Herodicos of Selymbria was one of the first to apply gymnastics in the treatment of disease during the years 428–347 B.C. In nearly every large city in ancient Greece gymnasia were set up. These became important centres where exercises were carried out and philosophers met for lectures and discussions. These buildings were often of great architectural beauty, and the ruins of many of them may be seen still.

Games were also of great importance, and before and after these we read of anointing the skin with oil and covering the body with powder and fine sand.

The writings of Hippocrates (380 B.C.) may well be followed at the present day. He said: " A physician must be experienced in many things, but assuredly also in rubbing, for things that have the same name have not always the same effect. For rubbing can bind a joint that is too loose, and loosen a joint which is too tight. Rubbing can bind and loosen; can make flesh, and cause parts to waste. Hard rubbing binds, soft rubbing loosens; much rubbing causes parts to waste, moderate rubbing makes them grow." In his writings Hippocrates uses the term " Anatripsis," which means the art of rubbing up and not down. In those days the circulation of the blood was not understood, but Hippocrates must have made careful and persistent observations to discover that rubbing upwards in the case of limbs had a more favourable effect than rubbing down, and we may conclude he produced the same effects we are achieving to-day, with regard to the absorption of effusion, the relief of blood stasis, and the carrying away of morbid products in the system.

With regard to his treatment of fractures and dislocations, his writings show that much of his teaching is in accordance with present-day methods. He stressed the importance of early reduction and traction in order to maintain alignment in a broken bone.

Galen lived during the second century A.D., and was a famous physician at Pergamos and Rome. He was an advocate of massage in the treatment of injuries and some diseases. He also advised gladiators to be massaged and anointed with oil in order to make muscles and joints supple before they engaged in fighting.

Galen discovered that arteries contained blood. Previously the ancients believed the arteries were filled with air. But many years were still to pass before the circulation of the blood was described by Harvey in the year 1628 A.D.

The following story will show that in early Roman times bathing and massage were much used :

The Emperor Hadrian, who died A.D. 138, " one day seeing an old soldier rubbing himself against the marble at the public baths, stopped him and inquired why he did so. The veteran answered, ' Because I have no slave to rub me ' ; whereupon the Emperor, pitying his condition, gave him two slaves and enough to keep them. On the following day, when the Emperor made his appearance, a number of old men began rubbing themselves against the wall, hoping to have similar good fortune, but the Emperor, divining their intentions, directed them to rub one another."

Towards the Middle Ages, massage seems to have fallen into disuse, at all events in Europe, but we hear of it again being used about the year 1580 by the great Ambroise Paré, the renowned French surgeon of the sixteenth century. At the beginning of the nineteenth century the whole system was revived and set on a scientific basis by Peter Henry Ling (1776–1839), a Swede. He established a school in Stockholm, which continues to the present day as the Central Gymnastic Institute. He adapted his exercises for those in health—educational gymnastics, and for the sick—medical gymnastics. In modern times Ling's medical exercises have been arranged and classified by Dr. Arvedson of Stockholm.

Within the last fifty years massage and exercises have been gradually brought into use as therapeutic agents in England. Before that time massage was used to a small extent, but those who practised it were people holding a somewhat anomalous position. There were few opportunities for training, and doctors had difficulty in finding competent workers to whom they might entrust their cases.

In the year 1894 a body of women joined in forming a

Society of Trained Masseuses with the objects of safeguarding the interests of the profession, and of furthering the science, study, and practice of massage. In 1900 the Society was incorporated by permission of the Board of Trade, and became known from that date as the "Incorporated Society of Trained Masseuses." This Society gradually increased the number of its members and the scope of its work until 1920, when it amalgamated with another society formed at a much later date. The same year the two together were granted incorporation by Royal Charter, and became known as the Chartered Society of Massage and Medical Gymnastics.

The work of the Society progressed still further, and it was found advisable to again change to a more comprehensive title, other forms of physical treatment having been added to the syllabus of study. The extra subjects included Light, Heat, Electricity and Hydrotherapy.

So from the year 1943 the Society became known as the Chartered Society of Physiotherapy. The title Physiotherapist superseded that of Masseuse and Masseur, and the members were allowed to use the letters M.C.S.P. after their name, or the unabbreviated title of Chartered Physiotherapist.

There are now over sixteen thousand members, and the Society is the largest of its kind in the world.

The aims of the Society are :—

1. To uphold the status and training of Physiotherapists.

2. To provide for the examination of and the granting of certificates.

3. To keep a roll of members.

4. To establish a Registry for members, and a centre of information for the public, on matters connected with physiotherapy.

5. To arrange lectures and to afford opportunity for the discussion of subjects of interest and importance.

6. To provide an organisation to which members have a right to apply for advice and help in professional difficulties, and in all things to promote efficiency in work, and the comfort and welfare of members of the Society.

The Rules of the Society are :—

1. Not to undertake cases except under the direction of a registered medical practitioner.

2. Not to advertise, except in recognised medical and nursing papers.

3. Not to sell goods to patients in a professional capacity, or to accept secret commissions on the sale of goods.

# CHAPTER II

HINTS TO BEGINNERS :—Personality—Educational standard—Treating patients in hospital—Private practice—The care of the patient—The Physiotherapist after training.

## PERSONALITY

THE student who wishes to qualify as a physiotherapist has important points to decide on the threshold of her career. She must decide whether she is fitted, both physically and mentally, for the work that is before her.

A good, all-round education is a necessity. In fact, matriculation standard or its equivalent is required by all training schools.

The student should be of good physique and sound general health is essential.

The hands must be suitable for massage. They should be broad, well padded, warm, dry, pliable, and without blemish of any kind.

There are many excellent institutions offering good practical and theoretical instruction. The course of training extends over a period of 2½ to 3 years, and when accomplished the student expects to sit for the examinations of the Chartered Society of Physiotherapy.

To gain experience in treating patients during her training the student will be required to spend time both in the wards and out-patient department of a hospital. She must here conform to the unwritten laws of hospital etiquette. She is, of course, under the jurisdiction of her own teachers, but she must also acknowledge the matron and sisters as her superior officers, remembering, whatever her position in the world, that for the time being she is subordinate to those holding office and responsibility in the institution where she works.

When privileged to treat a patient, she must carefully obey the orders given her, but do no more. If brought into contact with doctors, she addresses them as " Sir." She may ask for information as to the condition and treatment of the patient, but she must never offer her opinion unasked.

If entering a ward to treat a patient, the student should report herself to the sister-in-charge. This is customary and important, as it affords opportunity for orders to be given, and any changes in the patient to be reported. She must do her work quietly and methodically, and when leaving see that everything surrounding the patient is in the same order as she found it.

When training is accomplished and certificates gained, the worker is advised to acquire further experience by obtaining a post in an institution, where she may continue to work under the supervision of someone who has wider knowledge and experience than herself.

At this stage she must bear in mind that she stands but at the threshold of her career. There is still much to learn, and every opportunity must be taken of seeing new conditions, and acquiring further knowledge.

As well as actual technique and skill, there are certain ethical points to be followed. These include duty to patients, loyalty to doctors, and the upholding of the high standards of the Society of which she has become a member.

A good physiotherapist will never forget that such qualities as tact, sympathy, and a confident manner without aggressiveness are essential to success. She has become equipped not only with a means of independence, but also of helping the sufferings of her fellow-creatures, and she is under a moral obligation to do the best in her power for each one who comes under her care. This should be her aim, whether the patient be the humblest hospital inmate or the highest in the land.

In beginning private practice the physiotherapist must first make herself known to the doctors whom she hopes will employ her. This is best accomplished by introductions from other medical men.

When summoned to a patient she should give as little trouble as possible in the house, though necessary things must be asked for, and in all details consideration for the comfort and welfare of the patient is essential. The physiotherapist should be punctual in her attendance, and leave as soon as her work is done. She must be scrupulously particular about her person, and washing the hands before and after treatment is a rule never to be broken.

Some people advocate the patient lying between blankets

# CHAPTER V

PRACTICAL MASSAGE :—Hints for learning massage—Class instruction—Use of powder and lubricants—Arm—Wrist and hand—Elbow—Shoulder—Thigh—Hip—Back of the thigh—Knee—Lower leg—Foot and ankle—Back—Neck—Front of the neck and throat—Chest—Abdomen—Details of manipulations—Stomach—Liver—Intestines—Colon—Effects of abdominal massage—Contra-indications—General massage—Face massage—Head massage——Local heart treatment—General contra-indications to massage.

MASSAGE manipulations must be learnt and practised upon the human body. This is accomplished the best in a class, the pupils working in turns upon each other as models. It is important for the pupil to feel the manipulations of the teacher as well as those of her fellow students.

The comfort of the " model " should be considered. The part of the body worked upon must be well supported, and the muscles entirely relaxed.

The student must ensure a good position for herself. If working on the upper extremity and the abdomen, it is often allowable to sit. When working on the back and lower extremity it is generally necessary to stand, but whatever position is assumed, the feet must be parted and both kept firmly on the ground.

The student must accustom herself to continually think of the anatomical structure of the parts upon which she is working, and to feel for bony prominences, to localise the line of the joints, and the surrounding muscles and tendons.

She must become familiar with the handling of normal parts, before dealing with the abnormalities of disease and injury.

Though the term " physiotherapist " is in general use, in this chapter the operator will be called " masseuse," and the model be referred to as " the patient."

When the student begins to treat a " real patient," she should adhere to the routine she has learnt as far as possible, but she must adapt the manipulations according to conditions, *e.g.* one case may need much effleurage, and a small amount of petrissage and friction. Another may require much muscle kneading and deep friction. Tapotement is often useful, but in many conditions it is omitted altogether. The student discovers as she works, and according to the history of the patient, as to which manipulations are the most suitable for each case.

### THE USE OF POWDER AND LUBRICANTS

It is allowable to use a small amount of powder on the hands when at work. Its only merit, however, is to make the hands glide comfortably.

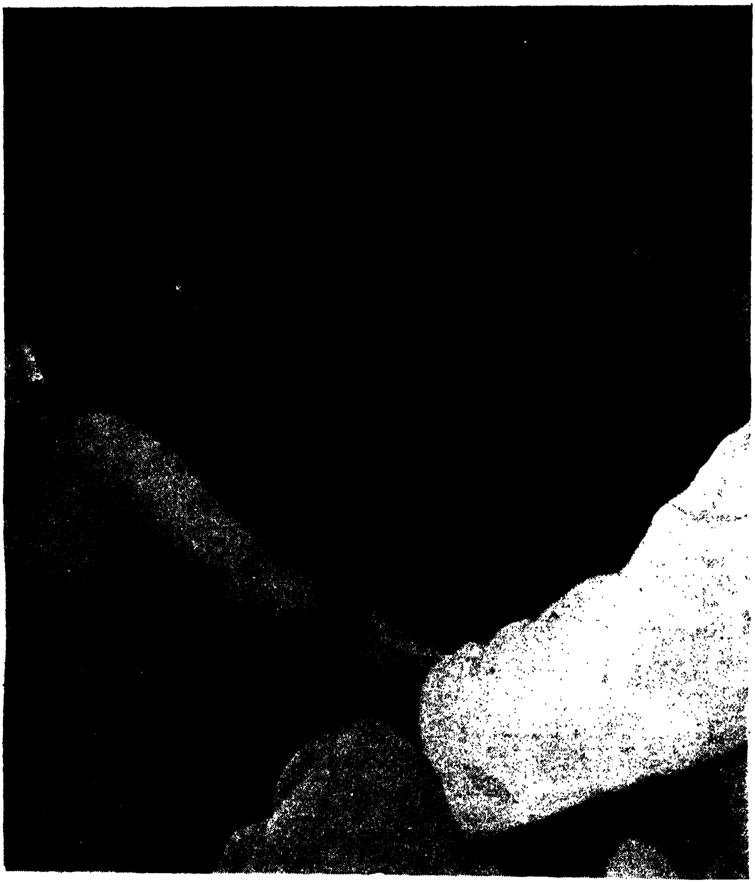

FIG. 9.—EFFLEURAGE OF THE ARM. MIDDLE OF THE STROKE

The powder should be soft, entirely free from lumps, and contain antiseptic properties. Highly scented powders should be avoided.

In the treatment of after-operation cases, fractures, and injuries a lubricant, *e.g.* olive or coco-nut oil, is more suitable.

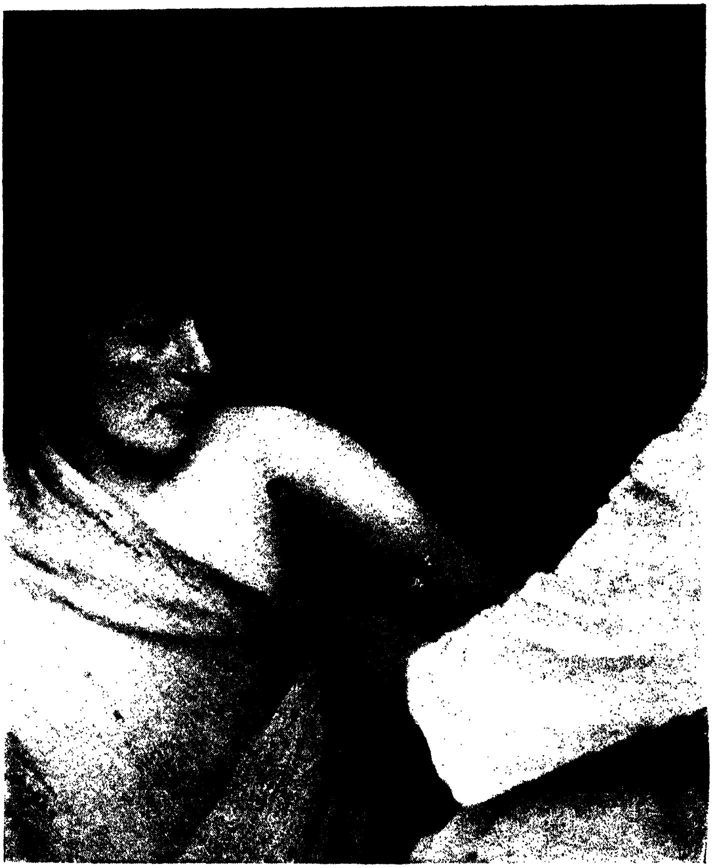

Fig. 10.—Effleurage of the Arm. End of the Stroke.

When the skin has been painted with iodine for an operation, it afterwards dries and peels off. This also happens when a part has been fixed by splints or plaster; the skin falls off in flakes. The dry skin is more easily removed by the use of oil, and the masseuse will be somewhat hampered in her work until this has taken place. Oils are also used for treating children, and those who are thin and emaciated. For these the lubricant may be used in larger quantities, with a view to nourishing and improving the tissues generally.

### ARM

*Position.* For the patient, sitting. For the masseuse, also sitting, but the seat should be a little higher than the patient's,

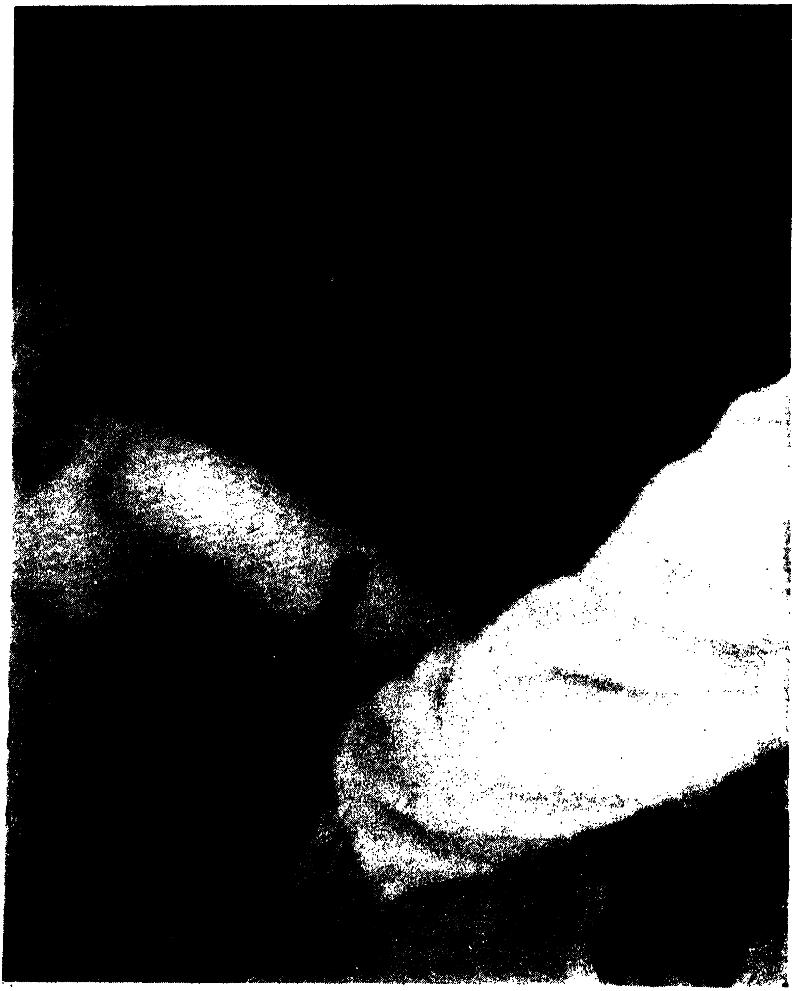

FIG. 11.—PETRISSAGE OF THE ARM.

for the masseuse has thus more strength and freedom than is possible when sitting on the same level as the patient.

Effleurage, from wrist to shoulder, first with one hand, then the other. Then both hands together. The strokes must be carried well up into the axilla. If the forearm only is treated, then the strokes finish at the elbow.

Petrissage of Biceps, Triceps, and Deltoid. Kneading of the upper arm. (This is sometimes continued to the wrist.) Picking up of the muscles and fatty tissues.

## FOREARM

Petrissage of the supinators and flexors. Kneading of the flexors and extensors with the base of the hand. Wringing. Hacking and clapping over the whole surface from the shoulder to the wrist.

In some cases it is well to massage in the following order —hand, forearm, upper arm, instead of beginning at the shoulder.

## WRIST AND HAND

*Position.* For the patient, sitting; the hand supported on a firm but padded surface. For the masseuse, sitting or standing.

Effleurage of the whole hand, on the palmar and dorsal surfaces, finishing the stroke just above the wrist (sometimes it may be carried to the elbow).

Effleurage of the fingers, the masseuse holding the patient's finger at the tip with one hand, while she performs effleurage with the other. The movement can be done with the tips of the three fingers.

Effleurage of the thumb, the masseuse supporting the patient's thumb by laying it along her own, and performing the movement with the thumb of the opposite hand.

Friction of the wrist, on the anterior and posterior surfaces, and over the dorsum and palm of the hand, working up and down between the metacarpal bones.

Friction of the fingers and thumb, holding in the same way as for effleurage, and the movement is performed with the ball of the thumb of one hand.

Petrissage of the thenar and hypo-thenar eminences done as a picking-up movement with the fingers and thumbs.

Hacking and clapping (sometimes omitted).

The muscles of the forearm are usually treated with the wrist and hand.

### ELBOW

*Position.* For the patient, sitting. The elbow and forearm supported upon a firm but padded surface. For the masseuse, sitting or standing.

Effleurage with one hand over the outer side, and with the other over the inner side.

Friction all round the joint.

Hacking.

Massage of the muscles above and below the joint.

### SHOULDER

*Position.* The same as for arm, the masseuse sitting a little higher than the patient.

Effleurage (*a*) With first one hand and then the other, carrying the stroke over deltoid to the axilla on the opposite side. The non-working hand is free to support the joint. (*b*) With both hands, and carrying the thumbs over the joint, finishing the strokes in the axilla.

Friction all round, following the line of the joint and working carefully round the acromion process. Caution is necessary when passing over the nerve trunks in the axilla. The excursions may be made two or three times, each one occupying about 4 minutes. The masseuse must support the joint throughout with her non-working hand.

Petrissage of all the muscles, working on the shoulder-joint.

Hacking (clapping, beating).

### THIGH

*Positions.* For the patient : (*a*) Lying, with the leg slightly flexed. The masseuse stands at the side. (*b*) Sitting, with back supported. The masseuse sits in front, and to the outer side of the leg treated. She takes the limb on to her knee. In this position she can fix her elbow against her own thigh or hip, and thus gain more power.

Effleurage, with one or both hands. The whole surface

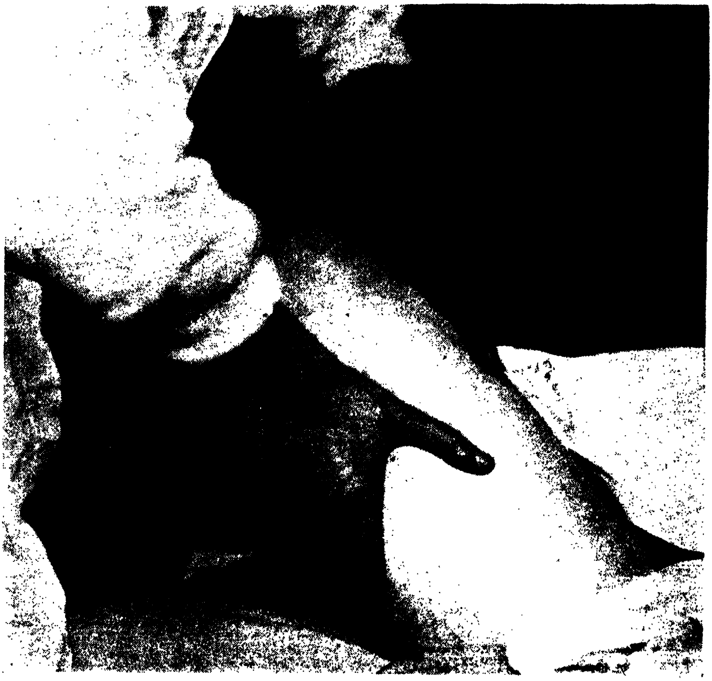

FIG. 12.—KNEADING OF THE THIGH.

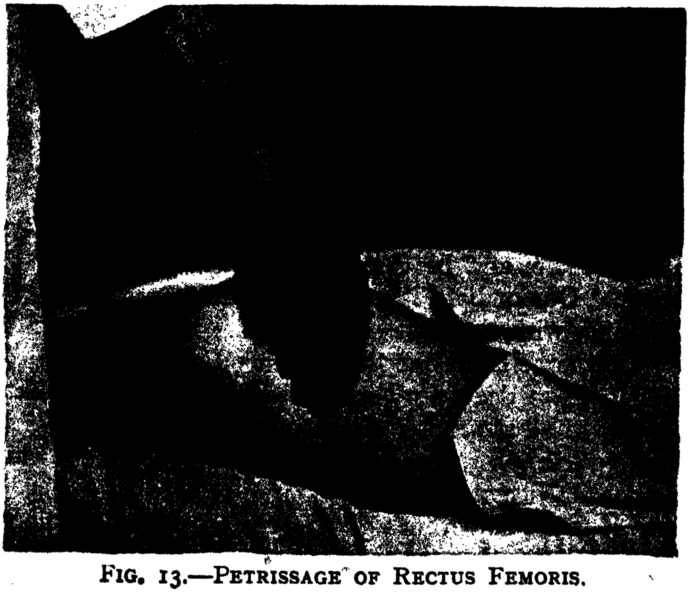

FIG. 13.—PETRISSAGE OF RECTUS FEMORIS.

must be covered, and it depends upon the size of the thigh as to how many strokes must be used. Those carried up the inner side end in the groin. Those up the outer side over the great trochanter, or else the hand is carried over the hip-joint, and the stroke also ends in the groin.

Petrissage of the adductors. Petrissage or kneading with the base of the hand down the outer aspect of the thigh. Petrissage of Rectus femoris (with the leg fully extended), with one or both hands, taking a wide grasp (Fig. 13). Kneading, both hands working alternately, first grasping the muscles on the inner and outer sides (Fig. 12), then on the upper and under surfaces of the limb. Picking up of adductors. Hacking and clapping over the whole surface.

## FRONT OF THE HIP-JOINT

*Position.* The patient lies supine, with knee and hip semi-flexed. The masseuse stands on the side of the hip she is treating.

Effleurage, with one hand, from without, inwards, carrying the stroke to the groin.

Friction across the line of the joint, and round the great trochanter.

Hacking, all over the area treated with effleurage and frictions.

## BACK OF THE HIP-JOINT

*Position.* The patient lies prone. The masseuse stands on the opposite side of the hip treated.

Effleurage of the gluteal region. The strokes must begin from the centre, and be carried out towards the groin in a fan-shape. One or both hands may be used.

Kneading, with the base of the hand. It is often suitable to work with one hand over the other.

Friction done deeply with the finger-tips of both hands. Picking up of all the muscles and fatty tissues.

Hacking, clapping, beating, the last being the form of tapotement most used in this region.

Vibrations are sometimes given over the gluteal region for soothing pain (see Sciatica treatment).

## BACK OF THE THIGH

If it is necessary to massage the hamstring muscles with more detail than that already described, it is usually done after the gluteal region, the patient maintaining the prone position. The masseuse stands on the same side as the leg treated.

Effleurage, from the knee to the gluteal fold.

Petrissage, with one or both hands, as given on Rectus femoris.

Friction and vibrations down the sciatic nerve (see Sciatica treatment).

Hacking and clapping.

## KNEE-JOINT

*Positions.* For the patient: (*a*) Sitting, with back supported. The masseuse sits in front, somewhat lower, and supports the patient's knee on her own. (*b*) Lying, with the knee fully extended, or slightly flexed. The masseuse stands at the side.

Effleurage. (*a*) Begin the stroke on the outer side with one hand, carry it up over the joint, and end it on the inner side, supporting with the opposite hand. (*b*) Begin the stroke on the inner side, carry it up over the joint, and end it on the outer side. (*c*) Both hands together, carry the thumbs over the front, and then over each side, ending underneath the joint. (*d*) Let the fingers of both hands meet behind, and just below the joint; carry the stroke up above, and finish it behind.

Friction round the patella, using finger-tips or thumb of one hand while supporting the joint with the other. One excursion round the patella may occupy 4 minutes, and should be repeated two or three times. Friction along the line of the joint, on each side and at the back.

Petrissage of the muscles above and below the joint.

Hacking and clapping.

## LOWER LEG

*Positions.* For the patient: (*a*) Lying, with the knee flexed and the foot supported. The masseuse stands at the side. (*b*) Sitting with back supported, the masseuse sitting in front, supporting the patient's foot on her knees. The patient's knee must be flexed to ensure relaxation of the calf muscles.

Effleurage, with one or both hands, beginning on each side of tendo Achillis, and carrying the stroke up each side of the leg to the back of the knee-joint. If a large surface must be covered a separate stroke may be used up the front and back of the leg. A stroke up the back of tendo Achillis may be done, allowing the tips of the fingers of both hands to meet each other.

Kneading of the calf muscles down each side of the leg, using one hand, and supporting with the opposite hand.

Kneading of Tibialis anticus with the base of the hand. Petrissage, wringing, and picking-up of the calf muscles.

Hacking and clapping.

### FOOT AND ANKLE-JOINT

*Positions.* For the patient: (*a*) Sitting. The masseuse takes the foot on her knee, sitting a little lower than the patient, and on the outer side. (*b*) Lying. The masseuse stands at the side.

Effleurage. (*a*) With both hands, one on the plantar, the other on the dorsal surface of the foot. (*b*) With one hand up each side of the foot. (*c*) With the finger-tips of both hands up each side of tendo Achillis.

Kneading with the base of the hand on the dorsal and plantar surface of the foot.

Friction, working first round the external malleolus, across the line of the joint and round the internal malleolus or *vice versâ.* On each side of tendo Achillis. On the dorsal surface of the foot, up and down between the metacarpal bones. On the plantar surface, and especially along the inner border if the treatment is for flat foot. Sometimes the tissues on the sole of the foot become very hardened; then it is necessary to friction with the knuckles instead of the tips of the fingers.

Hacking and clapping. The latter may be done on the plantar and dorsal surface, the hands clapping together instead of alternately. It is a useful method for warming the feet.

## BACK

*Position.* For the patient, lying prone. The masseuse stands at the side (the left is the most convenient).

The patient should wear a loose garment which opens down the back. The head must be supported on the couch without a pillow, and the face turned to the right or left.

Effleurage. (*a*) Begin the strokes over the gluteal regions, one hand on each side, carry them up over the angles of the ribs to the axillæ, and finish definitely there. (*b*) A similar stroke, but allow the thumbs to meet over the spinous processes. Also finish in the axillæ.

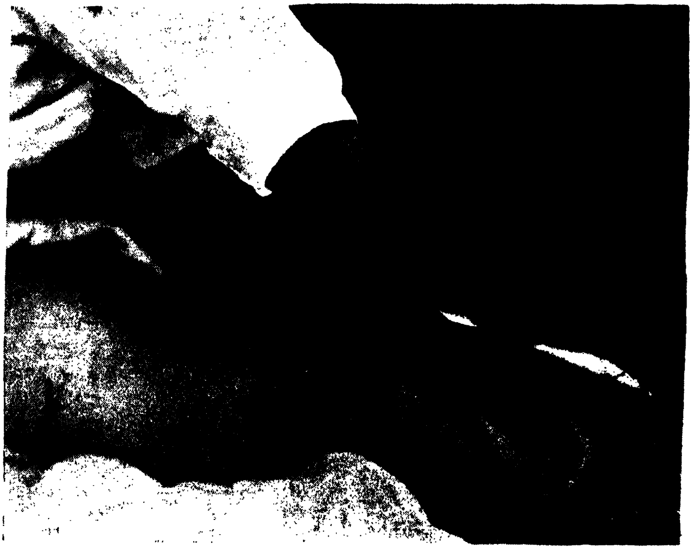

FIG. 14.—KNEADING THE BACK.

Kneading (also here called friction) with the base of the hand. A large stroke working on the muscles on each side of the spine, from the shoulder to the gluteal region. It may be done with one hand or both (one over the other to give extra power).

Kneading, with both hands, one each side of the spine. The hands move simultaneously and work from shoulders to gluteal region. A useful soothing movement, *e.g.* for Insomnia.

Friction down the spine, on each side, from the base of the skull to the sacrum. The circular movements should be performed with the tips of all the fingers, lying in a row, close beside the spinous processes.

Friction may also be given with the tips of the fingers of one hand or the pad of the thumb, each excursion moving towards the spine.

Friction with the finger-tips is sometimes necessary over the scapulæ and intercostal muscles.

Hacking. May be applied in several ways. (*a*) Spinal hacking. The movement is performed continuously, down each side of the spine, from the base of the skull to the sacrum. The hacking must be very light in the cervical region, and gradually stronger in dorsal and lumbar regions. As the hands descend, many strokes must be made; as they ascend, only a few strokes are made (4 to 6). (*b*) Diverging hacking. The movement is performed down each side of the spine, but the hands pass outwards and to the angle of the ribs, and back to the spine, while the hacking is done. When the ribs are passed, the spinal hacking is continued as above. (*c*) Hacking across the muscles, first on one side of the spine, and then the other, covering the whole surface.

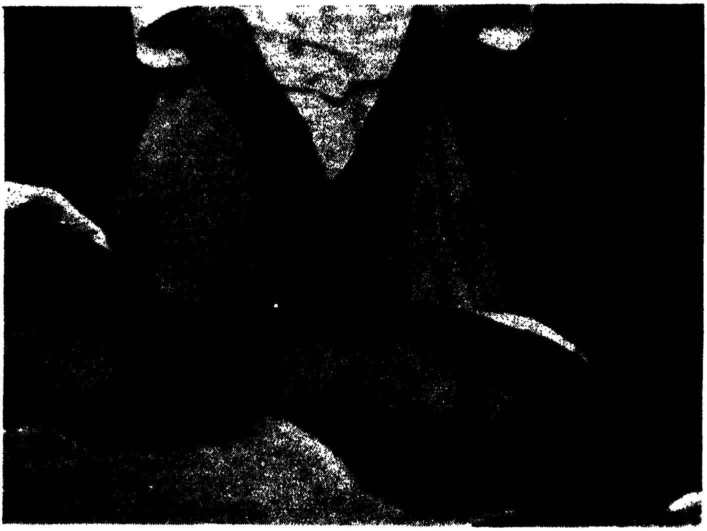

FIG. 15.—FRICTION DOWN THE SPINE.

The spinous processes must be avoided during hacking.

Clapping, all over the back, from shoulders to gluteal region.

Vibrations, with the whole hand all over the back.

Running vibrations, with the tips of the fingers down each side of the spinous processes.

## NECK

*Position.* The patient sits on a stool, leaning her arms on a table or plinth in front. The head must be supported. The masseuse stands behind.

Effleurage. (*a*) Begin the stroke with both hands at the level of the axillæ, and carry them up over Trapezius, ending with the thumbs lying parallel to and above the clavicle.

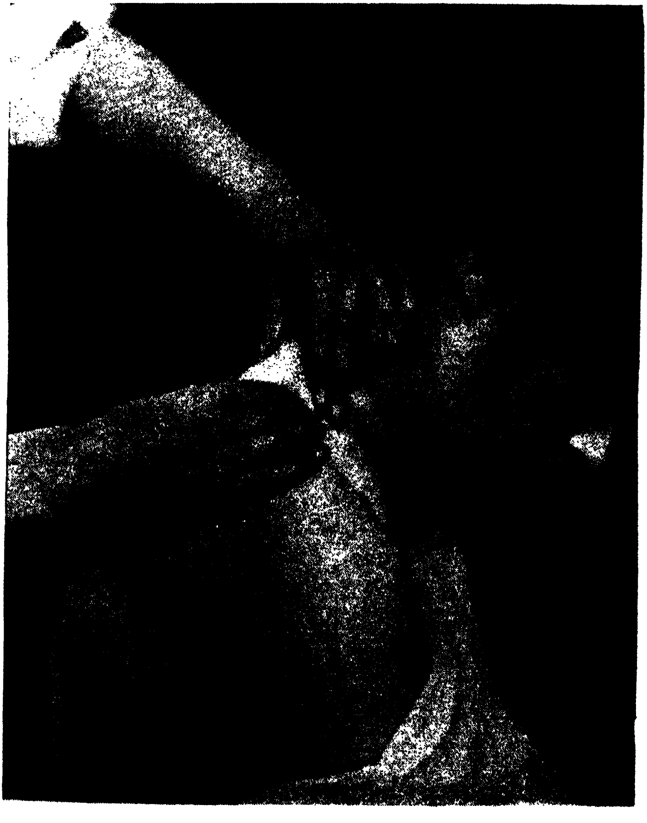

FIG. 16.—PICKING UP OF TRAPEZIUS.

(*b*) Down the sides of the neck to the clavicle, working the hand of the opposite side. (*c*) With one hand from the back, carrying the stroke over Trapezius to the clavicle, working with the hand of the opposite side.

Kneading, with the base of the hand. Picking up of Trapezius.

Friction, with the finger-tips, down each side of the spine, and over the scapula muscles.

Hacking, on one side at a time across the muscles, or diverging. The strokes must be very light in the cervical region, and stronger on the shoulders.

Clapping is not often used on the neck.

### FRONT OF THE NECK AND THROAT

*Position.* The patient sitting upon a stool. The masseuse stands behind and supports the patient's head against her chest.

Effleurage. (*a*) Let the ulnar borders of the hands meet under the patient's chin, and carry the strokes down to the clavicles. (*b*) With one hand down the front of the neck. (*c*) With one hand down each sterno-mastoid muscle.

Friction and petrissage of the sterno-mastoid muscles. Friction (gentle) down each side of the trachea.

Vibrations and shakings of the larynx and pharynx.

### CHEST

*Position.* For the patient, lying, but with the shoulders raised.

Effleurage. (*a*) Down each of the sterno-mastoid muscles. (*b*) With both hands up the sternum, then carrying the strokes out to the axillæ. (*c*) With both hands down the sternum, then carried out each side, over the lower ribs.

Petrissage and kneading of the pectoral muscles.

Frictions of the sterno-mastoid muscles, also above and below the clavicles and on the intercostal muscles.

Hacking, which must be done lightly.

All these manipulations must be done round the breasts and never upon them.

## ABDOMEN

*Position.* For the patient, lying with knees flexed. The shoulders must be slightly raised and the back well supported on a plinth or bed. The masseuse stands or sits at the right side.

### *Manipulations*

(*a*) For the stomach.
  Stroking and kneading, definitely following the course of the contents of the stomach.
  Stomach-pit shaking.
  Stomach shaking.
(*b*) For the liver.
  Stroking from out, forwards.
  Kneading, hacking, beating, pressing, and vibrations.
(*c*) For the intestines.
  Transverse stroking and kneading.
  Circular kneading.
  Colon stroking, kneading, and frictions.
  Lumbar side stroking, kneading and shaking.
  Transverse abdominal shaking.
  Vibrations.
(*d*) For the muscles and fatty tissues.
  The picking-up movement.

### *Details of Manipulations*

*Stomach-pit Shaking.* The masseuse places her hands at the pit of the patient's stomach, *i.e.* just below the ensiformis, with the palms facing each other and the fingers close together. The finger-tips rest on the patient's skin, and a vibration shaking movement is performed, while a slight pressure is made in an upwards direction. The movement is repeated 3 to 8 times. The patient breathes deeply, and the shaking is performed during expiration.

*Stomach Shaking.* The masseuse stands on the left side to perform this movement, facing the patient's feet.

The tips of all the fingers must be placed in a row along the greater curvature of the stomach, *i.e.* just below the border of the ribs, on the left side.

The patient breathes deeply, and during expiration the masseuse performs a vibration shaking, with slight pressure inwards and upwards. This also may be done 3 to 8 times.

*Manipulations for the Liver.* It is the most convenient for the masseuse to remain on the left side, though these movements can also be done from the right.

The patient must lie on the left side.

Stroking, with the left hand, from the back, round to the ensiformis.

Kneading, hacking, beating, most conveniently done with one hand.

Pressing or squeezing. One hand is placed behind and the other in front of the liver, and a stimulating squeezing movement performed with slight shaking. It may be done 6 to 8 times.

Vibrations, with the whole hand.

### *Manipulations for the Intestines*

*Transverse Stroking.* A preliminary movement, and also used between others.

*Transverse Kneading.* The hands are placed in the centre

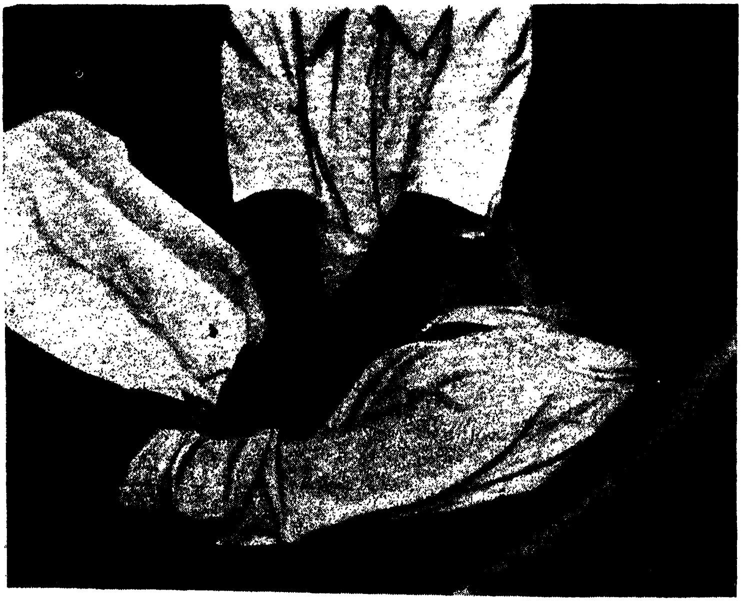

FIG. 17.—TRANSVERSE KNEADING OF THE ABDOMEN.

of the abdomen, overlapping each other, and a large side-to-side movement performed. The intestines should be grasped as much as possible. Care must be taken not to press upon the iliac crests.

*Circular Kneading.* The hands are placed as before, and a circular movement performed. The base of the hands, the ulnar borders, and the tips of the fingers are alternately pressed into the abdomen.

*Colon Stroking.* Performed along the course of the colon, the palms and dorsal surfaces of both hands being used, viz.: Up the ascending colon, the dorsal surface of the right hand lies upon the patient's skin, the left hand lying upon it with the palm uppermost. The hands turn sharply at the hepatic flexure, and the stroking is continued along the transverse colon. They turn again sharply at the splenic flexure, and here the palm of the left hand lies upon the skin, with the right hand over it, and the stroke is continued down the descending colon. The stroking may be done slowly, or briskly, according to the effect required. Extra stroking is sometimes necessary down the descending colon. It may be given 6 to 12 times.

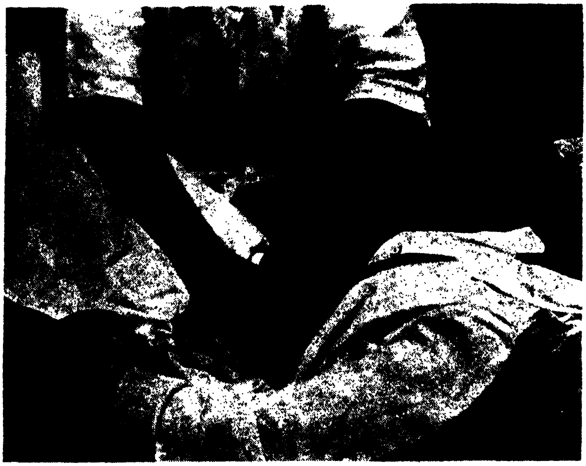

FIG. 18.—COLON FRICTION.

*Colon Kneading.* Performed along the course of the colon from the cæcum to the sigmoid flexure, with the base of the hand. It may be given 2 or 3 times.

*Colon Friction.* This also follows the course of the colon as in kneading. This manipulation is very important and may occupy from 5 to 15 minutes of the abdominal treatment.

The friction is done with the tips of the fingers of both hands, working close together and keeping the fingers straight. The patient should never feel the finger-nails, and the masseuse should guard against pinching minute portions of skin. The movement is performed slowly, circular excursions being made over every part of the colon. It is essential that the circles move with a view to pressing along the contents of the colon; they must therefore move upwards along the ascending, from right to left along the transverse, and downwards along the descending colon. This is the most usual method of treatment, but in some cases it is advisable to work backwards, *i.e.* treat—descending, transverse, and then ascending colon. If this method is followed, the circular frictions must still be working in the direction of the course of the contents of the bowel. If the descending colon seems loaded, it is sometimes well to treat it first, and give extra frictions upon it.

*Lumbar Side Stroking.* The masseuse places both her hands behind the patient, on each side of the spine in the lumbar region. She draws her hand sharply round to the front, as much as possible over the ascending and descending colon. At the end of the stroke the hands meet in front.

*Lumbar Side Kneading.* The hands are placed in the same position as for stroking, and a large kneading is done. The hands move alternately and are gradually brought round to the front.

*Lumbar Side Shaking.* This is done in the same way as the stroking, but as the hands are drawn forwards a shaking vibration movement is performed.

Each of these lumbar movements may be given 4 to 10 times.

*Transverse Abdominal Shaking.* One hand is placed in the centre of the abdomen, grasping the tissues. A movement is done beginning with a vibration and increasing to a definite shaking, which again decreases to a vibration. During this manipulation the hand gradually sinks into the abdomen and is lifted again.

*Vibrations.* These may be performed all over the abdomen, with one or both hands.

*Picking-up* has already been described on p. 12. It is used to stimulate the abdominal muscles, and also when there is an excess of fat.

### *General Effects of Abdominal Massage*

1. The abdominal walls and the muscles of the intestines are strengthened, thereby increasing peristaltic action.
2. Digestion is improved on account of the increased flow of digestive juices.
3. There is increased absorption in the stomach and intestines.
4. The portal circulation is promoted owing to the alternate pressure given on the abdomen.
5. The flow of lymph is increased.
6. It is sometimes the means of absorbing the products of inflammation, and stretching adhesions.

### *Special Effects of Manipulations*

*Stomach-pit Shaking.* This movement acts chiefly on the pyloric end of the stomach. It stimulates the nerves in the neighbourhood, also the glands, causing an increased flow of juices.

It is used in the treatment of chronic gastric catarrh and dyspepsia, also for atony and dilatation of the stomach.

*Stomach Shaking.* This movement is done over a larger area than the former, and is more effective in increasing peristalsis, and stimulating the mucous membrane.

*Effects on the Liver.* The stroking is soothing, but the other manipulations are stimulating, causing an increased flow of bile, and improving in general the functions of the liver.

*Effects on the Intestines.* The strokings are soothing. Colon stroking helps along the contents of the bowel. The kneadings and colon frictions are stimulating, and improve the muscle tone. They also help peristalsis, and the flow of juices.

Lumbar side stroking, kneading and shaking, also transverse abdominal shaking, are stimulating to the abdominal organs. They are much used in the treatment of chronic constipation.

Vibrations are soothing. They may be used over painful areas, and can sometimes be applied when other manipulations are contra-indicated. Some Swedish gymnasts apply vibrations to the abdomen in the treatment of diarrhœa.

### *Contra-indications to Abdominal Massage*

There are many conditions and changes during which abdominal massage must not be applied. The following are important examples :—

Pregnancy, throughout its course (except under special circumstances).

The menstrual period.

Any acute inflammation, *e.g.* peritonitis, perimetritis, abscess of the liver, etc.

Certain conditions of the kidneys, ureter, and bladder, *e.g.* stone.

Tumours, ovarian cysts, gall-stone, strangulated herniæ.

Acute catarrh, and ulceration of any part of the alimentary tract.

Any condition where there is danger of hæmorrhage due to ruptured blood-vessels, as abdominal massage raises the blood-pressure.

After recent bleeding from the brain, lungs, stomach, or from an aneurism.

## GENERAL MASSAGE

The term " General Massage " is applied to treatment of the whole body, except the head and face.

*Position.* The patient is in bed lying supine, with head and shoulders raised on a pillow.

Time : 40 minutes to 1 hour 15 minutes.

The masseuse should not exceed the time considered suitable for the patient's treatment. Much practice is necessary to allotting a definite time to each part of the body. The patient's comfort must always be remembered.

*Deep Breathing* : 4 to 6 times.

Then some or all of the following movements for each part :—

*Legs* : 10 to 15 minutes each.

*Foot* : effleurage, kneading, frictions, hacking, clapping ; passive movements in toes and ankle-joints.

*Lower leg:* effleurage, kneading, petrissage, wringing, hacking, clapping.

*Knee-joint:* Effleurage, frictions.

*Thigh:* Effleurage, petrissage, kneading with both hands, hacking, clapping.

Effleurage, from ankle to hip.

Passive movements in knee and hip.

*Arms:* 5 to 8 minutes each.

*Hand:* effleurage, kneading, frictions.

*Arm:* effleurage from wrist to shoulder, with one or both hands. Petrissage of all muscle groups.

Kneading from shoulder to wrist, hacking, clapping.

Passive movements in fingers, wrist, elbow, and shoulder.

*Back:* 5 to 10 minutes.

*Position.* Lying prone.

From the waist to axillæ, and over Trapezius: effleurage, kneading, frictions, hacking, clapping.

The lumbar and gluteal regions: effleurage, kneading, frictions, hacking, clapping.

*Chest:* 3 to 6 minutes.

*Position.* Lying supine.

Effleurage, frictions, petrissage of the pectoral muscles, hacking.

*Abdomen:* 5 to 15 minutes.

Stroking, transverse and circular kneading, colon stroking and frictions, lumbar side stroking.

Treatment for the stomach and liver may be added if necessary.

Active resisted movements should take the place of the passive movements described, as soon as possible.

## FACE MASSAGE

✓ Face massage improves the circulation and nutrition of the tissues. It aids the distribution of subcutaneous fat, and so may help to remove wrinkles. Its chief use, however, is for the treatment of nerves. Those to which massage may be applied are—branches of the trigeminal (the 5th cranial nerve), and of the facial (the 7th cranial nerve).

It is applied for the relief of neuralgia and neuritis, and for paralysis in the case of the 7th cranial nerve.

The accessible branches of the 5th cranial nerve are—the supra-orbital, the supra-trochlear, the infra-orbital, and the mental nerves. These are in pairs on each side of the face.

*Position.* For the patient, sitting, with back and head well supported. The masseuse stands at the side. Time: 10 to 20 minutes.

### *Manipulations*

Effleurage. (*a*) With the thumbs on the forehead, working towards the bridge of the nose. (*b*) Down the side of the face with one hand. (*c*) Over the cheeks, beginning the strokes with the thumbs lying on each side of the nose. (*d*) With the thumbs passing over the mental nerves.

Soothing stroking, vibrations and frictions, on all the nerves mentioned above. Soothing stroking over the whole face.

In facial paralysis special attention must be paid to the paralysed side.

Effleurage is given as above, but other movements are of a stimulating nature. Kneading, frictions, vibrations, hacking all over the affected area. This will be described further in notes on facial paralysis.

Time for the treatment: 15 to 30 minutes.

*Contra-indications to Facial Massage.* During a cold in the head. During swollen glands, or any inflamed condition.

## HEAD MASSAGE

Head massage is used in the treatment of rheumatism. It helps to break up inflammatory products in the scalp, and so relieves headache which is of rheumatic origin.

It is sometimes given to relieve a feeling of weight in the head in neurasthenia. Only a short treatment must be given to produce this effect.

*Position.* For the patient, sitting, with back supported, but not the head. The masseuse stands at the front or side. The patient's hair must be quite loose.

### *Manipulations.*

1. *Stroking.* The masseuse holds her hands somewhat claw-shaped, allowing her fingers to pass through the patient's hair. The finger-tips should be felt upon the scalp without scraping, and the hair lifted behind at the end of each stroke.

This movement is repeated between the others following. Time: 1 to 2 minutes.

2. *Light Hacking.* This is carried out in a definite pattern. The hair should be parted down the centre, and the hands follow the course of the parting on each side. The strokes are carried round to the back of the head and to the sides over the ears, then back to the starting-point. The movement is repeated, the hands working a little farther apart each time, till the whole surface of the head has been covered. Time: 1 to 2 minutes.

3. *Point Hacking.* The fingers of each hand are gathered together, and firm taps are made alternately all over the head, following the same course as in light hacking. Time: 1 to 2 minutes.

4. *Friction.* This is the most important manipulation. The masseuse supports the patient's head against her chest, standing at the side. Friction is performed with the finger-tips all over the scalp. It is important to move the tissues with each stroke, and a grating noise must not be heard. Time: 10 to 15 minutes.

5. *Stimulating Stroking or Combing.* The hands are carried through the hair in the same way as described in number 1, but this movement is done very briskly. Great care must be taken not to pull the patient's hair. If a soothing effect is required, this movement is omitted. Time: 1 to 2 minutes.

6. *Vibrations.* These are done with one or both hands placed on the patient's head. The masseuse stands at the back or the front. Time: 1 to 3 minutes.

7. *Light Brushing.* The hands are passed alternately and lightly over the patient's head, hardly touching the hair. The stroke may be carried down to the shoulders. This is a very soothing movement, and is useful in the treatment of insomnia. Time: 1 to 4 minutes.

### MASSAGE OF THE HEART OR LOCAL HEART TREATMENT

The manipulations applied in the region of the heart form only a small portion of the treatment given to cardiac cases. (See p. 331.)

*Positions.* For the patient, sitting, with back, head, and feet supported; or lying. The masseuse stands at the right side.

1. Soothing stroking over the heart. (This is repeated between each of the following.)

2. Light hacking.

3. Special tapotement over the heart. One hand is curved and carried backwards and forwards with an even swing, during which the palm of the hand touches the chest with a gentle tap. It is done in time with the heart beat.

4. Vibration.

This series is generally twice repeated. Time: 3 to 5 minutes.

*Effects and Uses.* The hacking is stimulating to the heart muscle and nerves, causing stronger and less frequent contractions. The special tapotement gives a rhythmical stimulation, which regulates the contractions. The vibrations and strokings are soothing.

### GENERAL CONTRA-INDICATIONS TO MASSAGE

There are many abnormal conditions when massage must not be applied.

The following are important examples :—

(*a*) When the temperature of the body is raised above 100°.

(*b*) Certain abnormal conditions of the skin, *e.g.* burns, erysipelas, syphilitic eruptions, etc.

(*c*) Some diseases of the blood-vessels, especially when the vessels are in a brittle condition. If massage is ordered in such cases, great care must be exercised.

(*d*) Acute varicose veins, phlebitis, lymphangitis, thrombosis, cancer and tumours, tuberculous bone and osteo-myelitis.

# CHAPTER VI

KINESIOLOGY :—Laws of Motion—Force—Equilibrium—Friction—Work—Energy—Gravity—Centre of gravity—Levers—Levers in the human body—Axes—Muscles—Muscle tone—Contraction and relaxation—Elongation—Elasticity—Muscle Actions—Prime Mover—Synergists and Antagonists—Ranges of working muscles—Fixators—Muscular control—Postural activity—The erect posture—Standing—Sitting—Walking—Running.

## KINESIOLOGY

BEFORE undertaking the study of the theory and practice of medical gymnastics, it is essential that the student understands the normal movements of the body, and how they take place.

Kinesiology is the science of living bodily movement. It necessarily includes some important facts studied in Physics and Mechanics, and also an extensive amount of Anatomy and Physiology.

When the movements of the body have been analysed, noting the functions of bones, joints, and muscles, the student will realise that the human body is a wonderful machine, more complex than any other in nature or invention.

## THE LAWS OF MOTION

In framing his famous laws, Sir Isaac Newton (1642–1727) taught, in his **first law,** " that a body continues in a state of rest or of uniform motion unless it is compelled by the action of external force to change that state." A ball will remain motionless, unless it is set rolling by some force outside itself. But when it is set in motion it continues to roll in a straight line and at a uniform speed, unless some outside influence causes it to change its course. If the ball rolls on unimpeded, it eventually stops on account of the resistance it meets in the air, and the friction of the surface over which it moves.

**Newton's second law** is concerned with momentum, and teaches that the rate of change in momentum of a moving body is proportional to the force causing it, and its direction is that in which the force acts.

**Newton's third law** teaches that for every action or force there is an equal and opposite reaction, which means that the force supplied in setting one body in motion results in an equal and opposing force being directed against some other body. In throwing a ball with his arm, a player directs a force against his own body. A long throw requires greater opposing force, than if the player wishes to send the ball only a short distance.

## FORCE

Force may be defined by its **magnitude, direction,** and **point of application.**

If two forces acting on a body are directed along the same line but in opposite directions, their **resultant** is the same as their difference, and acts in the direction of the greater pull. To illustrate this: if one locomotive exerts a pull of one hundred tons on a train, and another at the rear exerts a push of fifty tons, the resultant force applied to the train by the two forces is one hundred and fifty tons. If the rear locomotive is thrown in reverse, and exerts a backward pull of one hundred tons, then the resultant force applied in moving the train ahead is only fifty tons or the difference in force exerted by the two locomotives, and is in the direction of the greatest pull.

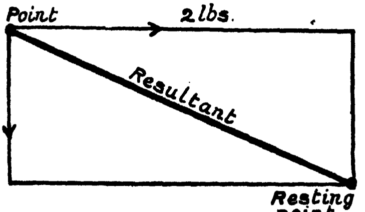

FIG. 19.

Forces are proportional to the accelerations they produce in a given mass, and may be measured by the product of the mass and the acceleration.

**Parallelogram of Forces.** If two forces act upon a point in two different directions, and their magnitude and direction is represented by two straight lines, the resultant force will then be represented by the diagonal of the completed parallelogram.

This is applicable in the body whenever two or more muscles assist in the same movement, pulling upon the same point with equal or a different amount of force, and in slightly varying directions, *e.g.*: (*a*) the various fibres of Deltoid in

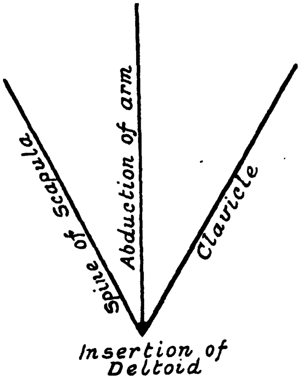

FIG. 20.

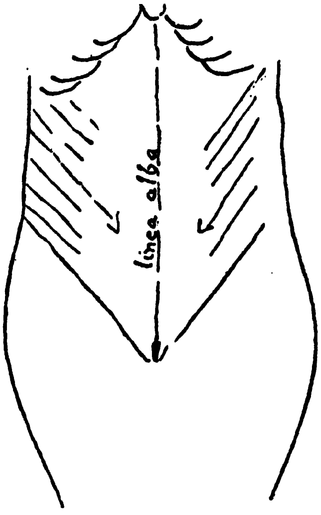

FIG. 20A.

Showing combined pull of Muscles.

abduction of the arm, (*b*) the combined action of Pectoralis major and Latissimus dorsi to adduct the arm, (*c*) the oblique muscles of the abdomen in bending the trunk forward.

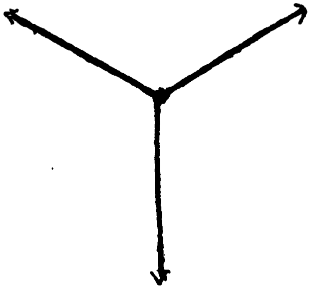

FIG. 21. Equilibrium.

If three forces acting at a point can be represented in magnitude and direction by the sides of a triangle taken in order (the sides being parallel to the forces they represent), they are in equilibrium.

**Equilibrium.** A body is in stable equilibrium when, if suspended like a pendulum and pushed to one side, it resumes its original position immediately beneath the point of suspension. A certain amount of oscillation occurs before equilibrium is regained.

In unstable equilibrium a body falls when pushed out from the vertical, *e.g.* an egg balanced on one end and then slightly disturbed will topple over rather than assume its first position.

**Friction.** When two surfaces are in contact and one slides over the other, a force opposing the motion comes into play.

This force is friction, and it is increased by roughening the surfaces.

**Work.** When a force moves its point of application it is said to do work, and the work is measured by the product of the force, and the distance moved parallel to the direction of the force.

**Energy.** Any system which is able to do work is said to possess energy.

**Kinetic energy** is the energy a body possesses on account of its motion. It is measured by the amount of work the body can do in coming to rest.

**Potential Energy.** Energy due to position or configuration is called potential energy, *e.g.* when a clock is wound up it possesses potential energy. This is maintained by a spring or a weight, but when the spring unwinds, or the weight falls, the potential energy is gradually converted into kinetic energy of the moving parts of the clock, and this becomes heat energy owing to the friction at the bearings, and the resistance of the air to the oscillation of the pendulum or balance wheel.

**Gravity** is the force which attracts bodies towards the earth.

**The centre of gravity** is that point in a body where the resultant of the earth's attraction works. The vertical of the centre of gravity is the line drawn from the centre of gravity in a given body to the middle point of the earth. As soon as this line falls outside the supporting area, the body falls, *i.e.* it is unstable.

The stability or steadiness of a body when placed in a particular position is increased by (*a*) lowering the centre of gravity, (*b*) increasing the area of the base, (*c*) increasing the weight of the body.

In standing, the supporting area of the human body is a triangle made up of the feet and a line between the toes. In close standing the area is decreased, and in stride standing it is increased (see pp. 82, 83).

The centre of gravity of the head lies almost in the middle of it, therefore its vertical line falls in front of the cervical spine. This necessitates the working of the muscles on the back of the neck to prevent the head falling forwards.

The centre of gravity for both head and body is at about the level of the 10th dorsal vertebra. Here the vertical line again lies in front of the spine, so in standing the back muscles must act to prevent the body falling forwards (see pp. 61, 75).

## LEVERS

A lever is a rigid bar which turns upon a fixed point called the **fulcrum.** There must be, besides, two forces acting upon the bar. One called the **weight,** the other the **power.**

There are three orders of levers, first, second, and third, and they are classified according to the positions of the weight and power in relation to the fulcrum.

A lever of the first order. The fulcrum is between the power and the weight.

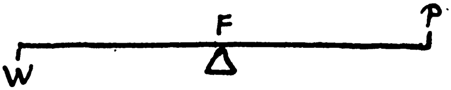

FIG. 22. Lever. First order.

An example of this is seen in lifting a block of stone with a crow-bar, and the common balance.

In the common balance the weight and the power are equal.

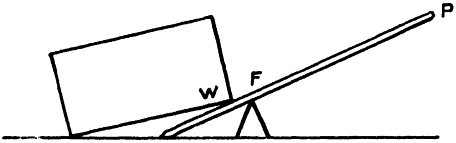

FIG. 23. Lever. First order.

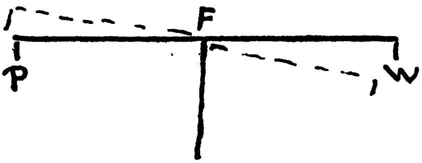

FIG. 24. Lever. First order.

A lever of the second order. The weight is between the power and the fulcrum.

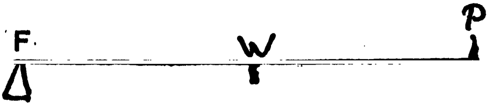

FIG. 25. Lever. Second order.

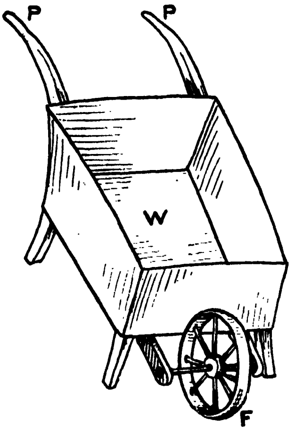

FIG. 26. Lever. Second order.

The mechanism of a wheel-barrow is an example of this order.

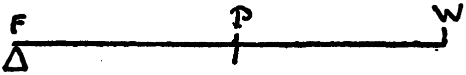

FIG. 27. Lever. Third order.

A lever of the third order. The power is between the fulcrum and the weight.

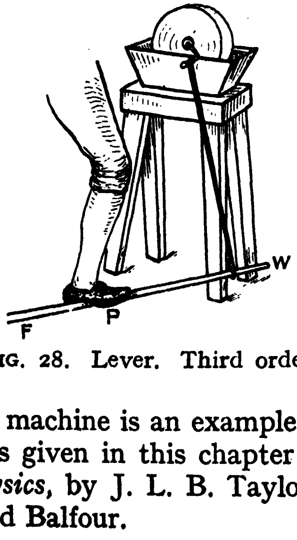

FIG. 28. Lever. Third order.

The treadle of a machine is an example of this order.

*Note.* The notes given in this chapter are gathered from the *A B C of Physics*, by J. L. B. Taylor; also from textbooks by Stead and Balfour.

## LEVERS IN THE HUMAN BODY

The following paragraphs on this subject are quoted from the writings of J. N. C. Davies-Colley, F.R.C.S., in *A Treatise on Human Anatomy* :—

" In estimating the effects of muscles acting upon the levers formed by the bones, each of which moves upon a joint as its fulcrum, three points have to be taken into consideration :—

" 1. The order of lever.

" 2. The distance, from the fulcrum, of the points of application of the force at the insertion of the muscle, and of the resistance to be overcome.

" 3. The direction in which the force is applied.

" It will be found that, whereas in most levers employed in mechanics the object aimed at is what is called **mechanical advantage,** i.e. by the application of a small force to overcome a greater resistance, in the human body the object is, on the contrary, by the exertion of a great force, through a small space, to overcome a small resistance, but at the same time to cause motion through a much greater space, and with a much greater speed. In the three orders of levers, the fulcrum is placed either between the power and the resistance (first order) ; or at one end, with the power at the other, and the resistance to be overcome between (second order) ; or at one end, with the power in the middle, and the resistance to be overcome at the other end (third order).

" The power required to overcome the resistance varies inversely with the distance of its point of application from the fulcrum. Where this distance, or the arm of the lever as it is called, is short compared with the arm at which the resistance acts, then the power has to be greater than the resistance, and *vice versâ.*

" In the first order of levers, if the power and resistance act parallel to one another, there may or may not be a gain of mechanical advantage, according as the area at which the power acts.

" In the second order of levers, there must necessarily be mechanical advantage ; and in the third order the power must be greater than the resistance, as it has to act upon a shorter arm, so there will be what may be termed mechanical disadvantage.

"In the human body there is hardly a single muscle which forms a good example of a lever of the second order, for the simple reason that mechanical advantage is of so much less importance than a wide range of movement with its attendant rapidity. . . .

"The muscles which are inserted into the tendo Achillis are often given as an example of this order of lever, when by their contraction they raise the heel and lift up the body, the weight of which acts upon the lever of the foot through the ankle joint. . . .

"It will be found that most of the muscles belong either to the third order, in which there is necessarily mechanical disadvantage, or to the first order; and in this case, the arm at which the power acts is usually the shorter, so that the power has to be greater than the resistance. In the movements of the forearm about the elbow as a fulcrum, the Triceps, acting with the very short arm afforded by the projection of the olecranon and overcoming a resistance experienced by the hand at the other end of the radius and ulna, will be a lever of the first order. . . .

"The Biceps and Brachialis anticus are both of them good examples of the third order of lever, when they act by their insertion close to the fulcrum of the elbow to flex the forearm, the centre of gravity of which is much farther from the joint."

### AXES OF THE BODY

An axis is a point, real or imaginary, round which movements take place.

The three axes of the body are :—

Vertical.
Sagittal.
Frontal.

*The vertical axis* (or longitudinal) may be considered as a line drawn through the body from the centre of the head to a point between the feet. Rotation movements take place round this axis.

*The sagittal axis* lies parallel to the vertical and also to the sagittal suture of the skull. Certain side movements take place, *e.g.* trunk bending sideways.

*The Frontal Axis* (or transverse). This is at right angles to the other two, it also lies parallel with the coronary suture of the skull. Bending the trunk forwards and backwards in the hips takes place in this axis.

### PLANES OF THE BODY

The three planes of the body are :—

Vertical.
Frontal.
Horizontal.

*The vertical median plane* lies through the centre of the body, dividing it into two equal parts. A saggital plane is also vertical and lies parallel to the median.

*The frontal plane* is one at right angles to the median.

*The horizontal plane* is one at right angles to the median and frontal.

### MUSCLES

In recent years important discoveries have been made by scientists concerning the physiology of muscle tissue.

**Muscles** are the source of all the energy the body can use to move itself and other things. They have the power of contraction and relaxation. They also possess elasticity and extensibility.

**Muscle tone** is a condition which is always present. It is a certain tension controlled by the nervous system, and very variable in intensity ; *e.g.* it is greatest during excitement, less when a person is quiet, still less during sleep, and reduced still farther in some conditions of paralysis.

**Contraction and Relaxation.** Sir Colin Mackenzie, in his *Action of Muscles*, explains that when a movement takes place it is due to a double physiological action. There is contraction of one or more muscles, producing a shortening of the muscle, because the origin and insertion of the muscle are approaching each other. At the same time the opposing muscle relaxes and elongates. The stimulation which causes a contraction also causes a relaxation of the opposite muscle or group of muscles.

**Elongation or extensibility** of a muscle is not a physiological action. It must be preceded by relaxation. It is the result of mechanical action, and whether it takes place in voluntary or involuntary muscle it depends on an outside force for its production.

**Elasticity** is only slight in muscles, but it varies through life. The muscles of a child have the greatest elasticity, and as life lengthens the elasticity decreases. This accounts for the fact that a child rarely sprains his muscles, while older people are much more liable to do so.

### MUSCLE ACTIONS

It is not possible for anyone to throw into action a single muscle. When a movement is performed a principal muscle contracts if it is known as a **Prime Mover.** It is always assisted in its movement by others. These assisting muscles are called **Synergists.** Very often the synergic muscles inhibit movements not required, *e.g.* the fingers are bent by flexor muscles (prime movers), the extensors of the wrist may work at the same time to prevent flexion of the wrist (synergists).

**Antagonists** are those muscles performing opposite movements, *e.g.* triceps is an antagonist to biceps; Gluteus maximus an antagonist to Psoas.

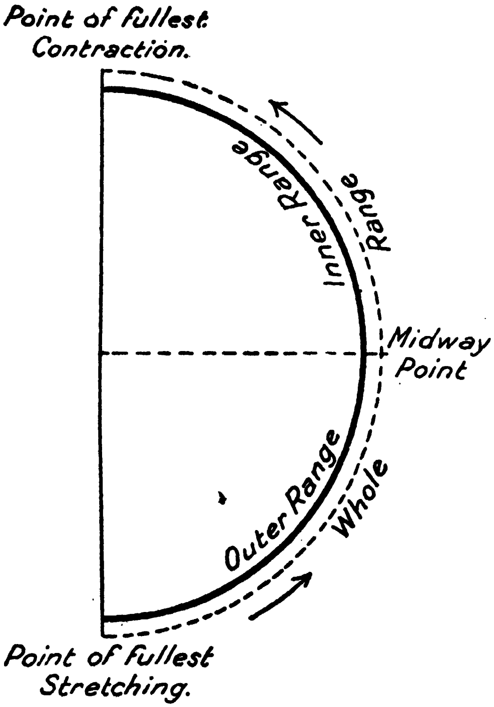

FIG. 29. Ranges of Working Muscles.

### THE RANGES OF WORKING MUSCLES

A muscle works in its whole range by performing a movement from its most stretched position to its fullest contraction. A muscle works in its inner range by performing a movement from a point midway between full stretching and full contraction to its fullest contraction. It is also called working the muscles in shortening.

A muscle works in its outer range by performing a movement from its most stretched position to the point midway between full stretching and full contraction. It is also called working the muscles in lengthening.

Muscle work in the inner range is used with the object of shortening an over-lengthened muscle. It is the form required in the treatment of the lengthened muscles of all deformities.

Muscle work in the outer range is used with the object of bringing fresh blood and nutrition to the muscle group, without carrying the contraction to its fullest limit.

It is also a means of teaching muscle control to a nervous patient, *e.g.* in chorea.

The above description applies to concentric muscle work in the different ranges. When eccentric work is necessary the movement is done in the opposite direction.

*Note.* Concentric and eccentric muscle work is explained on p. 102.

**Fixators** are those muscles fixing a part while others perform a movement.

## MUSCULAR CONTROL

Every muscle fibre is an independent unit possessing the power of contraction. Each muscle fibre has a nerve fibre through which it is controlled by the central nervous system.

Sir Colin Mackenzie says :—

" The muscle is really part of a nervous mechanism. The motor nerve and the muscle are functionally interdependent. It is true that the source of motion resides in the muscles, but the cause of voluntary movement resides in the nervous system. Through nerves the will-power is conveyed, but nerves have no power of motion. Both the nerve and muscle are best considered as parts of an original unit, the muscle retaining the power of contractibility, of producing motion, and the nerve retaining the power of irritability and of conduction."

It is also important to remember that movements are represented in the nervous centres, and not in individual muscles.

## THE POSTURAL ACTIVITY OF MUSCLES

Sir Charles Sherrington has taught that the upright position of the body is maintained by continuous reflex muscular activity—and so it is evident that the skeletal muscles are concerned in the maintenance of posture, as well as in the execution of movement.

The muscles acting upon the spine work in a complicated way. The large groups which lie in the long axis are concerned with movement and are under voluntary control. Some authorities consider that the small deep groups of spinal muscles are concerned only with muscle tone and posture, that they act reflexly, and are not under the control of the will. The large groups, however, are concerned with both movement and posture. They have been described as the anti-gravity muscles, viz., the extensors of the head, spine and hips.

The nervous impulses controlling active voluntary movements arise in the cerebral cortex which is the seat of consciousness. Those controlling tone and posture receive impulses from organs of sense, viz., eye and ear, also from muscles and ligaments and from the skin.

From these sources they pass to special nerve centres which reflexly return impulses to the muscles concerned, causing their state of tone to be increased or diminished.

Posture, therefore, is maintained unconsciously by tonic contraction, and it can continue indefinitely without fatigue. A perfect balance of the body is thus obtained, and it includes not only the trunk muscles as described, but those of the limbs as well.

Postural activity is acquired in early life. " A new-born child cannot hold up his head, still less can he support his body in the upright position. This is not because the muscles are too weak, but because the nervous mechanism for these actions is not yet developed. In due course, by constantly repeated voluntary effort, the child learns to hold up his head, then to sit, to stand, and finally to walk.

" The upright position thus acquired laboriously by voluntary effort, then becomes habitual and sub-conscious and is maintained by reflex tonic muscular activity (postural activity).

" When the child begins to stand, the feet are flattened and everted by the body-weight; this, again, is not because the muscles are weak, but because postural activity is not yet fully developed.

" When the child learns to walk postural activity becomes established, and the feet are adducted and inverted, that is, the tendency to passive abduction and eversion is from that time onwards constantly resisted by reflex tonic muscular activity (postural activity)."—*Bankart.*

### THE ERECT POSTURE

There are nearly 200 pairs of muscles in the body, and about 75 pairs are involved in general posture and movement.

The human being is the most erect of any of the vertebrate animals. Sir Colin Mackenzie tells us that man alone possesses the prefrontal brain with the characteristic forehead, and that human intelligence depends upon the erect posture. The position is an unstable one, and we know that many months of a child's early life is expended in acquiring balance and the muscle control required for standing and walking.

" In the erect posture the pelvis is placed obliquely with regard to the trunk. The pelvic inlet forms an angle of from 50° to 60° and that of the outlet one of about 15° with the horizontal plane. . . . In consequence of this obliquity of the pelvis, the line of gravity of the head, which passes through the middle of the odontoid process of the axis, and the points of junction of the curves of the vertebral column to the sacro-vertebral angle, descends towards the front of the cavity, so that it bisects a line drawn transversely through the centres of the heads of the thigh bones. . . ."

" The weight of the skull and its contents is directly transmitted to the pelvis and lower extremities when the body is in the erect position " (*Gray*).

**The Standing position** is maintained by the action of the flexors and extensors of the trunk, and the extensors of the hips. The weight of the body rests upon the hips, and as soon as slight flexion in these joints occurs, the hamstrings, gluteii, and erector spinæ begin to work, to prevent the body falling forwards. If the body is again carried back, the extensor muscles relax, and those of the abdomen take on the work. The ilio-femoral ligaments prevent over-extension at the hip-joints, and are important agents in maintaining the erect posture. Owing to their support, the hip-flexors mostly remain at rest during standing; they only come into action if there is extra strain. The calf muscles also work in standing, and the flexors of the foot to grip the floor.

## SITTING

When the sitting position is taken, there is flexion at the hips, knees, and ankles. The body is supported on the ischial tuberosities. The centre of gravity lies vertically between the two. The legs and feet are the fixed points, and gravity assists to carry the body down to sitting position. The inclination of the pelvis should be the same as in standing.

Children should learn correct sitting. The femur should be supported from hips to knees, and the feet rest on the ground in the fundamental position. The ribs and chest must be raised, and the head held up. If a chair back is used, it should be flat, and high enough to support the head.

To assume standing, the legs and feet are again the fixed points, and the extensors of knees and hips work to raise the body.

## WALKING

Walking is a very complicated action, involving the greater part of the muscular system.

"The centre of gravity of the body is continually being moved forward, and is first on one side of the sagittal plane and then on the other, each leg alternately providing support."

When a man starts walking with the left foot the body falls forward, so that the line of gravity is made to fall in front of the supporting surface. At the same time the left ankle, knee, and hip-joints are bent and the leg carried forward to prevent the body falling while the right heel is lifted and the right foot is flexed. When the left foot has reached the ground the right foot is strongly extended, and the body is thrown forward again, the right ankle and knee are immediately bent, and the leg swings forward like a pendulum. It swings as far in front of the other leg as it was behind, and again reaches the ground to prevent the body falling.

The pendulum movement is assisted by the flexors of the right hip. By this time the left leg has been stretched so that it is straight at the time that the right leg passes it.

As soon as the right leg is in front, the left heel leaves the ground, and when the right foot is on the ground the left ankle is strongly stretched, which drives the weight of the body on to the right leg again. The weight of the body is transferred continually from one leg to the other.

### RUNNING

In running, the body first falls forwards and the left foot is carried forwards, but before it reaches the ground, the right foot is so strongly extended that the body is thrown from the ground in an arch upward and forward, so that for a moment it hangs in the air before the left foot reaches the ground. By means of the impetus the body continues its way forwards, and as soon as the body weight is in front of the left foot, there is strong extension in ankle, knee, and hip, which again drives the body into the air and forwards. During this time the right leg and foot have swung forward to maintain the balance of the body.

In walking, the back foot is not extended before the front foot has reached the ground, so that for a certain movement in each step both feet are on the ground at the same time, and one foot is always on the ground. In running, the extension of the back leg takes place before the front foot reaches the ground, so that there is never more than one foot on the ground at a time, and for a moment after the extension of the back leg, there is no foot on the ground at all.

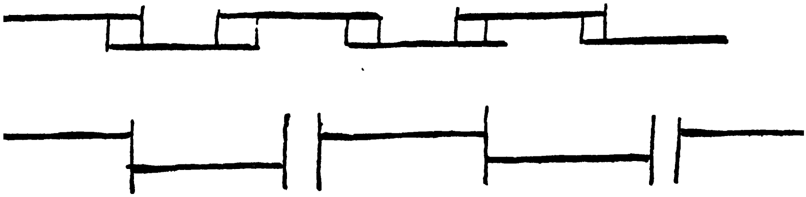

FIG. 30.—DIAGRAM SHOWING MOVEMENT OF FEET IN WALKING AND RUNNING.

# CHAPTER VII

MUSCLE RE-EDUCATION :—General notes—Force of gravity—Friction—Line of pull—Changes of leverage—Re-education—The board—In water—Suspension.

MUSCLE re-education is an important part of the treatment of patients suffering from the effects of injuries, deformities, and various forms of paralysis.

If an effort is made to use a muscle to its full extent when it is in a weak condition, the result will be often unsuccessful, also the muscle will be so fatigued that further efforts will be still more useless. All the movements, therefore, should be made to a small degree at first, and then gradually increased as the strength of the muscle improves.

When attempting a movement the weakness of the muscles is often shown by a trembling of the limb. If this is the case, rest between and after the movements is essential.

It must be remembered that an injured muscle cannot react normally to the impulse it receives. Opposing groups of muscles, however, if uninjured, are ready to do their work as usual, and on this account inco-ordination of movements may arise. Exercises to restore co-ordination are, therefore, of great importance.

In the early stages of a treatment a patient may be quite unable to do a certain movement, but as a preliminary may learn to contract the muscle. To do this the physiotherapist asks him to make the tendon tense, or to try to make the thick part of the muscle stand out. The patient may first attempt the contraction on his sound limb, and later on the one to be restored.

As soon as a small amount of movement is possible the patient should be encouraged to move the part, let him see for himself which muscles become taut ; and even though the movement has not returned let him attempt to send an impulse from his brain, making an effort to perform the movement with the injured limb, for, although unsuccessful at first, the effort will help the brain cells eventually to work again. It is very important in these cases to gain the patient's co-operation.

A paralysed limb should always be handled gently. When removed from a splint it must be carefully supported.

To re-educate weak, injured or partly paralysed muscles, movements or exercises are given. The exercises are regulated by certain mechanical advantages :

(*a*) **The Force of Gravity.** This may help or hinder a movement, but the limb may be so placed that the force of gravity is eliminated.

(*b*) **Friction.** It is important to reduce the amount of friction which the limb may encounter, *e.g.* if lying on a blanket, or soft cushion, the limb may be unable to move, whereas if placed on a polished surface or a sheet of cardboard some movement is possible.

(*c*) **The Line of Pull.** A movement is easier or harder according to the obliquity of the muscle with the long axis of the bone on which it is acting. The movement becomes easier when the pull on the bone becomes more perpendicular. Therefore the less the obliquity, the easier the movement.

(*d*) **Changes of Leverage.** By lengthening the lever arm the difficulty of a movement is increased.

### RE-EDUCATION

When a patient has accomplished a small amount of muscle contraction as shown above, he must pass on to something more difficult. But further movements will only be accomplished by care and perseverance on the part of both patient and physiotherapist. The latter must have the knowledge of what is required, and the patient must co-operate in carrying out what he or she is told to do.

Various points must be noticed :—

The patient's position must be comfortable so that relaxation is possible.

Gravity must be considered, as already explained.

Muscle ranges must be considered (see p. 58) and work in the inner range should be first attempted.

Eccentric work is easier than concentric, so this again must be tried first, but the concentric work should be approached as soon as possible. Later the patient does free movements, and last of all some resistance is given by the physiotherapist, Treatment must often continue for weeks, and throughout the time passive and assisted movements are given, but a watch must be kept for every sign of active work, and the patient continually encouraged to accomplish the movements as they recover.

Often some muscle groups remain normal, while others are paralysed. This may lead to serious deformity if neglected, and also to trick movements which must not be allowed during the period of recovery.

Throughout the treatment the physiotherapist supports the joint to be moved with one hand, and has the other hand free to feel for the first flicker of movement in the muscles, also to assist and resist as the case may be.

When some progress has been made, various means are brought into use to help the patient.

### THE RE-EDUCATION BOARD

Sir Colin Mackenzie has advised the use of a sheet of card or a polished board in the re-education of muscle groups. The limb must be fully supported and the board is placed beneath it. The smooth or polished surface is a great help as friction is much reduced.

The board can be placed horizontally (gravity is *eliminated*) or at different angles, and by this means a movement is made harder or easier.

If moving on a " downward grade," gravity is *assisting*. But such a movement, though it seems to be helping, is done without muscle contraction, so progression should be made to a more advanced movement as soon as possible.

If the board is placed so that the limb moves in an " upward grade " gravity is *resisting*.

As explained above ranges (p. 58) also concentric and eccentric work (p. 102) must be considered throughout the treatment.

This method is the most useful for re-educating muscle groups of the upper extremity, and also for children.

### RE-EDUCATION IN WATER

This is known as pool therapy, and is now much used, but obviously the patient must attend or be in residence where a special pool has been provided for the purpose.

Pool treatment is much used for children suffering from Anterior poliomyelitis, and in spastic conditions it is valuable. The water so buoys up and supports the limbs that movements are assisted.

Pool treatment is also helpful in the treatment of rheumatic diseases. Movements and exercises are devised by the physiotherapist and are varied according to requirements. In all these conditions the training of co-ordination is of great importance.

It may be of interest to note here that the late President Roosevelt, who was a victim of Anterior poliomyelitis, paid regular visits to Warm Springs in Virginia. He found bathing in the waters there of great benefit to his condition.

Pool therapy is of great value, but is not always available. Some pools have been built under cover, where both air and water can be maintained at a suitable temperature. Others are placed in the grounds of institutions, and owing to changes of climate can only be used for a limited part of each year. Other means of supporting the limbs are, however, in use.

### THE USE OF SUSPENSION IN RE-EDUCATION

A suspension apparatus has been devised by Mrs. Guthrie Smith, M.B.E., M.C.S.P., and is much used in re-education. She writes :—

" It is possible to suspend a limb or body at selected points, and in this way to balance out the *effect of gravity*, or, in other words, to transfer the weight and dead inertia of the paralysed part to the apparatus.

" The weight of a single limb is a very considerable item, from 1 to 2 stone in the leg, and from 7 to 15 lb. in the arm."

As well as ruling out the effect of gravity, *friction* is decreased by the use of correctly suspended slings.

The apparatus consists of overhead bars suitably supported. Pulleys run on the bars and cords pass over the pulleys. The sling or slings which support the limb are attached to the cords which are adjustable in length.

The limb is placed in the sling and movements may be performed passively, actively with resistance, and also by active swinging and pausing during movements, the physiotherapist giving commands for the suitable pauses.

The slings may be adapted to suspend the trunk and head, as well as the limbs. When the body or part of it lies in the slings, movements may often be done which the patient cannot otherwise actively accomplish. The body is supported and relaxed, and the operator's hands are free to be used in "skilled movements of assistance, resistance or palpation." In a sling movement may take place by the weakest of muscle effort, and in the swinging pendulum movements already mentioned, action is induced in a natural way.

Fatigue must always be considered in weak and paralysed muscles, and the limbs can be suitably rested when supported in the slings.

*Chief Uses.*

1. In cases where relaxation is very important, *e.g.* fractures and spastic paralysis.
2. In giving manipulations and mobility exercises.
3. In re-educating muscles, *e.g.* in early Anterior poliomyelitis.

## MRS. GUTHRIE SMITH'S SUSPENSION APPARATUS

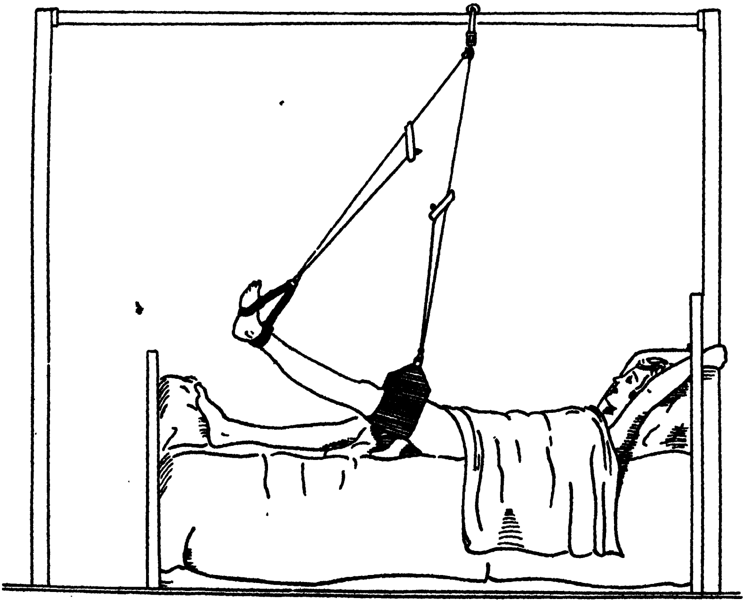

FIG. 31.—SUSPENSION APPARATUS, SUPPORTING LEG DURING RE-EDUCATION EXERCISES.

*Lent by Mrs. Guthrie Smith.*

The student is referred to Mrs. Guthrie Smith's book on *Rehabilitation and Re-education*, where her methods are described and illustrated in detail.

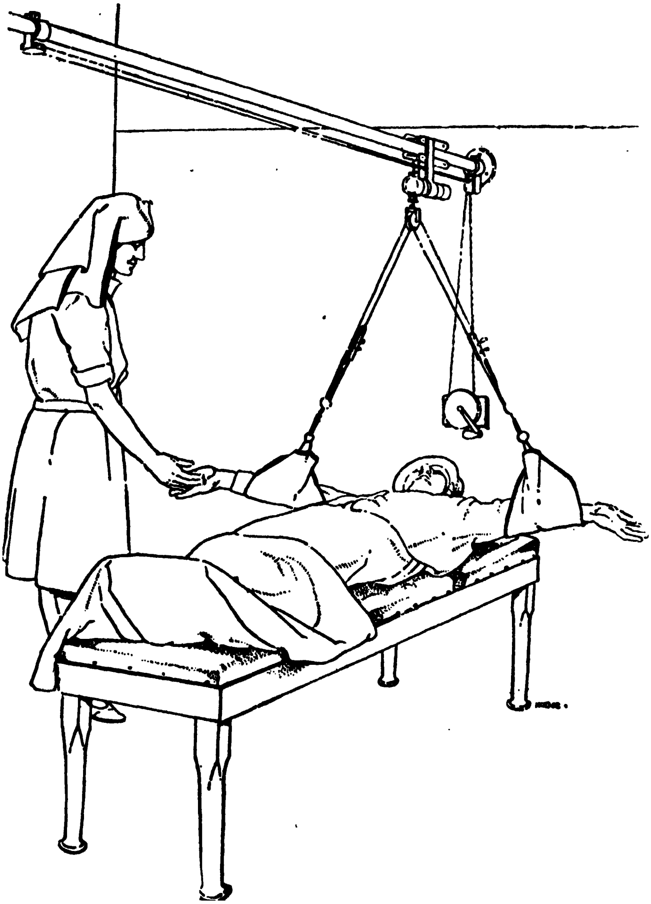

FIG. 32.—SUSPENSION APPARATUS, SUPPORTING THE ARMS DURING RE-EDUCATION EXERCISES.

*By permission of Mrs. Guthrie Smith and Messrs. Faber & Faber.*

When the body or a part of it lies in the slings, movements may often be done which the patient cannot otherwise actively accomplish. The sling takes the weight of the body or limb while the patient gives his maximal strength and attention to performing a movement.

# CHAPTER VIII

RE-EDUCATION OF SPECIAL MUSCLE GROUPS:—Upper extremity—Shoulder — Elbow — Wrist — Fingers — Occupational therapy — Lower extremity—Hip and thigh—Knee—Ankle—Foot—Re-education after leg injuries—Trunk muscles.

## RE-EDUCATION OF SPECIAL MUSCLE GROUPS

### THE UPPER EXTREMITY

**The Shoulder Region.** In paralysis of Deltoid, Trapezius, or Serratus Magnus, there is inability to raise the arm from the side to the vertical position.

*Treatment of Deltoid.* The arm is usually placed on an abduction splint for rest.

*To Re-educate.* The patient lies so that his back, head and shoulders are supported on a re-education board. First he lies flat and attempts to abduct the arm. Movement is first given in the inner range. Difficulty is increased by changing the angle of the board, and the range and strength of the movement is gradually increased.

When abduction is accomplished, the movement of carrying the arm forward and backward by the anterior and posterior fibres of Deltoid must also be trained.

*Treatment of Trapezius and Serratus Magnus (Anterior).* When the upper part of Trapezius is paralysed, the limb is again placed on an abduction splint.

*To Re-educate these Two Muscles.* The arm is again placed on the re-education board and the movement done in the inner range, beginning from the position of abduction, and gradually increasing until the vertical position is reached, *i.e.* the full range. It is also important for the patient to obtain a static control of the muscles which are being retrained. This must be attempted at intervals.

All the shoulder movements should be done first with the elbow flexed and later with it extended.

Should the muscle power be very weak the physiotherapist tilts the board, making a downhill surface for the limb (*gravity assisting*).

Later, attempts should be made to lift both arms together.

### FURTHER EXERCISES TO RE-EDUCATE SHOULDER MUSCLES

*Crawling* up the wall with fingers. First it may be done facing the wall, but as soon as the patient can abduct a little, he should stand sideways, so that the arm is raised in true abduction from the body.

The patient should try to touch his throat, chin, forehead, and the back of his neck.

Double-sided free movements, *e.g.* two arm flexion and extension in various directions, placing hands on wall bars and eventually climbing the bars.

**The Elbow Region.** Either flexors or extensors may require re-education. The patient lies with his arm on the re-education board, and with the help of the physiotherapist performs the movements, beginning in the inner range. The strength and range is gradually increased as before described.

**The Wrist Region.** The hand first lies on the board upon its ulnar border, the patient attempting flexion or extension or both. Again the movements are first tried in the inner range and eventually are given in the full range.

If the hand is placed in supination over the edge of the support, and extension is attempted, the movement is helped by the weight of the hand (gravity assists).

If placed in pronation over the edge of the support and extension is attempted (gravity resists). It is first done in the inner, progressing to the whole range of movement.

This procedure is used in the treatment of wrist-drop (p. 368).

For flexors it would be done in the opposite way, but the movement is not often required in this region.

Slings (when available) are of great value in the early stages of all arm injuries and paralysed conditions.

Not only must power be regained in a disabled hand, but co-ordination of fine movements require training.

Many things may be devised for retraining—*e.g.* any hand and finger exercises with which the physiotherapist is familiar may be taught. Finger exercises on the piano. Squeezing a rubber ball, and closing the fingers over it.

Various games where the fingers and thumbs must be brought together.

Apparatus is usually found in physiotherapy departments of hospitals for encouraging and strengthening the finger and hand movements.

As well as movement being impaired by injury to motor nerve fibres, sensation may be lost or altered by injury of sensory nerve fibres and others influencing muscle sense (controlling sense of position) may be affected. For such conditions exercises should be devised for giving the patient practice in re-education of the sense of touch by feeling the difference between soft and hard things, and for the muscle sense by placing the limb in various positions while the eyes are closed. First, place the sound limb in a position with the eyes open, and then attempt the same with the injured limb, with the eyes closed.

Opportunities are given to patients to attend *occupational therapy departments*. These are specially arranged to give employment to disabled persons during their time of recovery. Various activities are arranged for those with partially disabled hands, *e.g.* weaving, rug-making, leather work, toy making, etc.[1]

## THE LOWER EXTREMITY

### The Hip and Thigh Region.

*Quadriceps Extensor.* Rest is essential for a paralysed quadriceps. The limb must be supported on a back splint. When lifted from the splint for re-education the limb must never be allowed to hang down.

The patient must be taught to contract the muscle, and be instructed to practise the contractions often.

*To Re-educate.* The patient lies on the side of the sound leg. A re-education board is placed under the paralysed limb, and from a semi-flexed position the leg is extended. Assistance is first given, but as strength returns the movement is done freely and then with resistance.

Later the patient lies on his back and attempts straight leg raising. (Gravity is resisting owing to the weight of the limb.)

***Flexors and Extensors of the Hip.*** These may also be re-educated in a similar way, the patient lying on his sound side, and the board being held by the physiotherapist, the patient attempts flexion and extension in the joint. *The*

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[1] Text-book—*Theory of Occupational Therapy*, by N. A. Haworth, M.A.M.R.C.S., and E. M. Macdonald.

*gluteii extend the hip when the knee is in extension. The hamstrings also help extension.*

*Abductors and Adductors of the Hip.* The patient in lying position attempts abduction and adduction (single or double) with the assistance of the physiotherapist. He must also practise muscle contractions in this region. The position ensures a pure movement of abduction and adduction.

*Flexors of the Knee.* The patient lies on his sound side as before, the re-education board under the affected limb. He attempts to flex the knee, the physiotherapist then carries the limb back to the extended position. Later, the patient lies prone, and attempts to flex the knee to a right angle. (Gravity resists owing to the weight of the limb.) *The hamstrings help to extend the hip, they also flex the knee.*

*Flexors and Extensors oj the Ankle.* The patient lies on his sound side, the re-education board under the foot. The patient attempts to flex and extend the foot as required with assistance from the physiotherapist, or to perform the movement in both directions.

Movement may also be attempted in prone lying, with the foot over the edge of the support.

*Inversion and eversion* may be attempted in a similar way.

*Note.* Whenever slings are available they are invaluable in the re-education of all muscle groups of the lower extremity. Especially for adults, as they take the weight of the limb which may be a serious hindrance to movement.

## RE-EDUCATION AFTER LEG INJURIES

Routine ward exercises for patients in bed are given on p. 140, but in the case of leg injuries these should be increased. If a limb is encased in plaster the patient is instructed to move the joints which are left free.

The strength of the unimpaired limb must be kept up by daily exercises. Therefore, while still in bed the patient may do the following singly or doubly according to circumstances.

*Lying.* Toe flexion and extension.

Foot flexion and extension, also moving the feet alternately.

Inversion and eversion.

Single and double knee flexion and extension, also moving the joints alternately.

Later the patient sits on the edge of the bed and repeats the knee movements together and alternately.

*For the Hips.* The leg is drawn up as high as possible and extended again. Repeated with other leg.

*Crook Lying, Knee Parting and Closing.* The patient must tense the muscles during the movement.

Fractures are often encased in plaster. When the injury is below the knee, the plaster is often so applied that the patient is able to walk about, *e.g.* Pott's fracture (see p. 197).

When plasters are discarded and in those cases where they have not been used the following may be done :—

Reach, grasp or wing standing, heel raising. Alternate heel and toe raising. Knee flexion and extension. Alternate knee raising and sinking. Raising on to outer borders of the feet and sinking again. Marching along a line, avoiding eversion of the feet, also marching in following order—heel, outer border, toe.

It is important to throw the weight of the body equally first on one foot, then on the other.

*Note.* For other balance and marching exercises, see p. 129.

## TRUNK MUSCLES

To re-educate abdominal muscles which have been paralysed, easy exercises in progression may be devised, beginning with breathing exercises, abdominal contractions, head raising, and trunk raising.

*Trunk Raising.* This must first be done with the patient sitting, the back well supported, and the knees fixed by the operator. The patient raises from the support and leans slightly forward. To progress, the patient sinks farther back, to half-lying, and eventually to sit-lying, and from one of these starting positions raises to sitting, the operator fixing the knees.

Exercises for lateral and oblique muscles may be devised, the patient lying or sitting, and side bendings and turnings are attempted (pp. 134, 135). Exercises for the back and neck may also be chosen, according to the patient's capacity (pp. 130, 135).

# CHAPTER IX

GYMNASTIC POSITIONS :—Fundamental positions—Derived positions from standing—Sitting—Lying.

## Gymnastic Positions

STARTING positions for all exercises must be taken and correctly maintained as far as possible.

In active work, the positions should give the working muscles a steady origin.

In passive work, the position aims at relaxation of joints and muscles.

The abbreviations in general use are given.

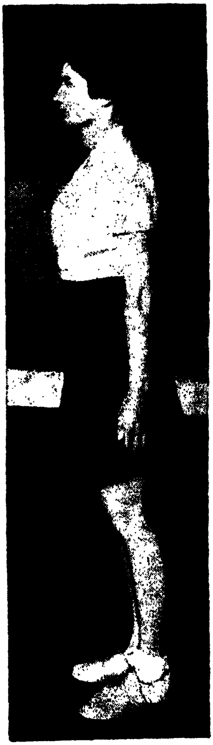

FIG. 33.—STANDING.

### Fundamental Positions

| | |
|---|---|
| Standing . . | St. |
| Kneeling . . | Kn. |
| Sitting . . | Sitt. |
| Lying . . | Ly. |
| Hanging . . | Hg. |

*Standing* (*St.*). The body is vertical, heels together, toes turned out, the feet forming an angle of 70°. Knees and hips fully extended. Shoulders drawn back and down. Head up, chin in, eyes front. Arms close to the body, with extended elbows, wrists, and fingers.

The standing position, when taken and maintained, improves the bearing of the body. The chest is made broader, the thoracic and abdominal organs are not compressed. The position is not a steady one, as the standing base is small, and the centre of gravity lies high above the base, *i.e.* between the 3rd and 4th sacral vertebræ.

The position is important, as it is much used for free exercises, and many other positions are derived from it.

**Working Muscles.** (a) Posterior neck muscles, because the line of gravity lies in front of the cervical spine. (*b*) Back muscles, because the line of gravity of both head and trunk together falls in front of the spine. (*c*) The back shoulder muscles, to draw the shoulders back and down.

At the same time the following muscles work continuously to a slight degree to maintain balance in standing—Flexors and Extensors of the hips. The Quadriceps to keep the knees in full extension. Also dorsal and plantar flexors of the ankle-joint. All the groups work statically to maintain the position.

"The ilio-femoral ligament is an important factor in maintaining the standing position. When on the stretch it keeps the body erect with very little muscular work" (*Gray*).

*Kneeling* (*Kn.*). The knees are placed a little apart and the feet are just over the edge of the support. Otherwise the position is the same as standing.

The kneeling position is steadier than standing, because the supporting base is larger, and the centre of gravity is nearer the base.

**Working Muscles.** Those of the neck and back are the same as in standing. The Quadriceps femoris works a little more to control balance, but the muscles of the lower legs and feet do nothing.

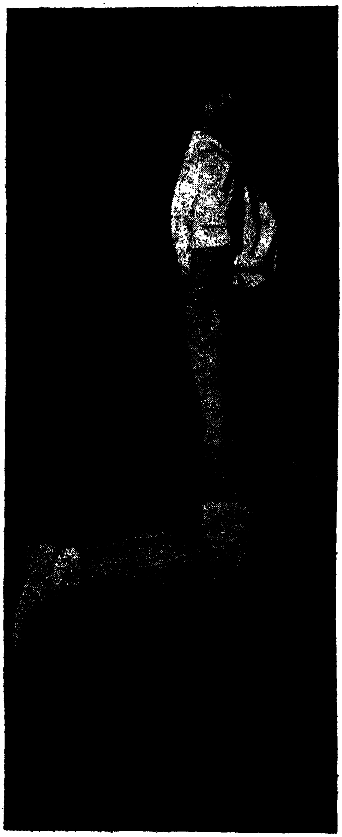

FIG 34.—KNEELING.

*Sitting* (*Sitt.*). Sitting is usually taken on a stool. The body rests upon the Tuber ischii, and the femur. The feet rest upon the floor, and there should be a right angle at the hips, knees, and ankles.

The sitting position is much used. It is steadier than stand-

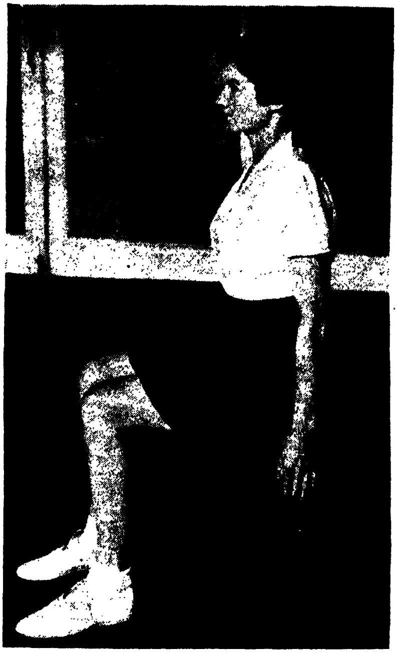

Fig. 35.—Sitting.

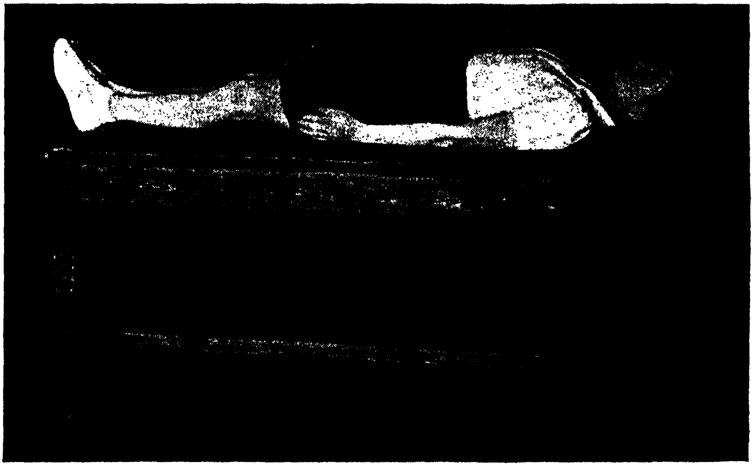

Fig. 36.—Lying.

ing and kneeling, as the base is larger and the centre of gravity lower. The pelvis is supported.

**Working Muscles.** Those of the neck, spine and back shoulder muscles, as in standing; also the extensors of hips, viz., Gluteus maximus and medius, to prevent the trunk falling forwards.

*Lying* (*Ly.*). The patient lies on his back on a plinth or on the floor, supported from head to ankles. The position is the same as standing, except that the body is horizontal instead of vertical.

The lying position is restful. It is used for weak patients, for children, and is the most usual for massage.

No muscle work is required to maintain the position.

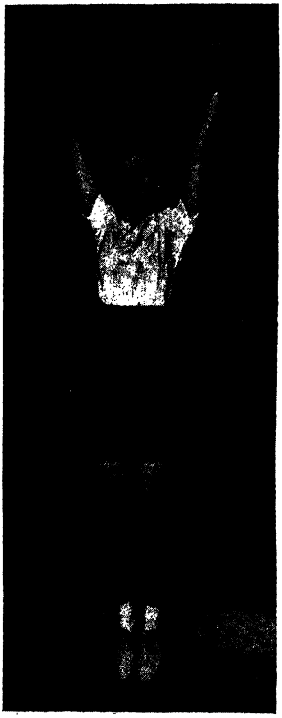

FIG. 37.—HANGING.

*Hanging* (*Hg.*). The patient grasps a boom or bar with the hands shoulder-width apart. The arms hang straight, and the head is carried slightly back. The position is otherwise much the same as standing. The body must not hang slack. The patient must be instructed to slightly contract the arm and shoulder muscles, also those of the back and abdomen, to prevent over-stretching of ligaments. The legs should be held together, knees fully extended, and the ankles plantar-flexed. The feet must not touch the ground.

The position stretches the spine and is used in the treatment of scoliosis. The chest is fixed, so respiration is hindered. The position should not be taken by heart, lung or weak patients.

**Working Muscles.** Flexors of the fingers to grip the bar. The flexors and extensors of the wrist; also the pronators. The inward rotators and depressors of the scapulæ. The erector spinæ and the abdominal muscles. The extensors of the hips, knees and ankle-joints. All these muscles work statically.

## Derived Positions from Standing Fundamental Position

### BY MOVING THE ARMS

*Hips Firm or Wing Standing* (*Wg. St.*). The hands are placed on the hips, fingers in front, thumbs behind. The elbows must be kept in a line with the body. The shoulders back and down.

The weight of the arms is supported by the iliac crests. The chest is somewhat expanded.

The position is much used when giving trunk exercises.

**Working Muscles.** For taking the position. The abductors of the shoulder, viz., Deltoid and Supra-spinatus. The pronators of the forearm. Flexors of the elbow, viz., Biceps, Brachialis anticus. The extensors of the wrist. The muscles all work concentrically.

To maintain the position. The hands are pressed on to the iliac crests by the adductors of the shoulder, viz., Pectoralis and Latissimus dorsi. The elbow extensor Triceps also assists. The muscles all work statically.

*Bend Standing* (*Bd. St.*). The elbows, wrists, and fingers are flexed. The fingers are placed on the shoulders. The elbows must be kept close to the sides and the shoulders drawn back and down.

This is the starting position for all arm extensions.

**Working Muscles.** The outward rotators of the shoulder, viz., Supra and Infra-spinatus; also Teres minor. The flexors of the elbow, wrist and fingers. The muscles work concentrically, then statically.

*Yard Standing* (*Yd. St.*). The arms are abducted to the level of the shoulders. The elbows and fingers are fully extended. The palms of the hands are turned downwards.

The position expands the chest slightly. It improves the position of the shoulders, as back shoulder muscles work strongly.

**Working Muscles.** Abduction of the shoulder by Deltoid and Supra spinatus. In taking the position there is also slight movement in the (*a*) acromio-clavicular joint, and the muscles working are Serratus magnus and the lower part of Trapezius; also in (*b*) sterno-clavicular joint moved by the upper fibres of Trapezius. Triceps works to main-

**tain the extended forearm. These groups work first concentrically and then statically.**

*Swim Standing, or Across Bend Standing* (*Acr. Bd. St.*). The elbows are flexed, and the fingers meet across the chest. The hands are kept in a horizontal plane, palms downwards. This is the starting position for arm casting.

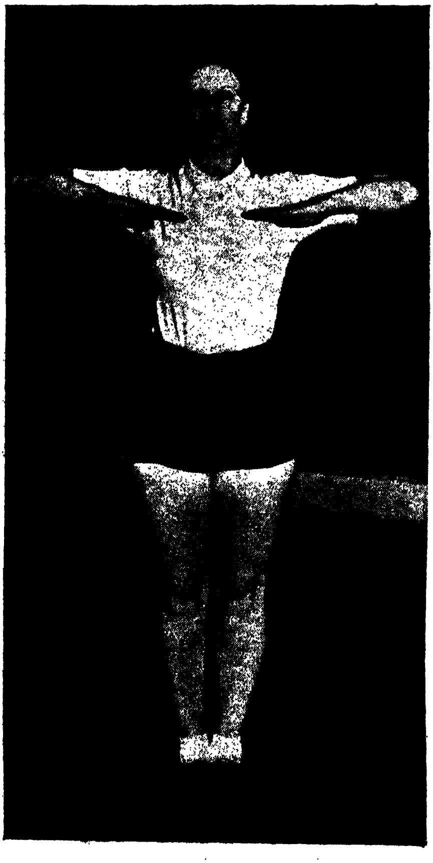

FIG. 38.—ACROSS BEND STANDING.

**Working Muscles.** The same as in Yard Standing; also the flexors of the elbow. The posterior fibres of Deltoid and the middle part of Trapezius work and maintain a good position of the shoulders. All concentrically and then statically.

*Heave Bend Standing* (*Hv. Bd. St.*). The arms are abducted to the level of the shoulders. The forearms are carried up and placed at a right angle to the upper arms. The palms are turned inwards and the fingers held extended.

The position is used in giving a passive chest expansion, when the effect of the movement is a little stronger than in swim and yard positions.

**Working Muscles.** The same as in Yard Standing; also the outward rotators of the shoulder, viz., Supra and Infra spinatus and Teres minor. Biceps and Brachialis anticus flex the elbow, and with the supinators they work statically and maintain the position.

*Reach Standing* (*Rch. St.*). The arms are carried forwards in a horizontal plane, the hands are kept shoulder-width apart, the palms face each other.

The position slightly compresses the thorax.

**Working Muscles.** The flexors of the shoulder joint, viz., Pectoralis major, Coraco Brachialis and the anterior fibres of Deltoid work concentrically to take the position.

Trapezius acting on the acromio-clavicular joint, and Serratus magnus on the scapula, also work slightly. All work statically to maintain the position ; the extensors of the elbow and wrist also taking part.

*Reach Grasp Standing* (*Rch. Gr. St.*). The same as the last position, but the hands also grasp a bar.

The position is used to fix the body.

*Neck Rest Standing* (*N. Rst. St.*). The hands are placed behind the neck. The fingers meet at the tips. The elbows are drawn back. The head up and chin in.

The position expands the chest. It raises the centre of gravity and so makes an exercise harder. It improves the position of the head. It is the position generally used for " Chest Clapping." If one arm only is raised, it is used in the treatment of scoliosis to raise a low shoulder.

**Working Muscles.** The same as in Yard Standing ; also the outward rotators of the shoulder-joint. The flexors of the elbow and supinators of forearm work concentrically to take the position and statically to hold it.

The back and shoulder muscles must also be made to work to maintain a correct posture.

*Stretch Standing* (*Str. St.*). The arms are stretched up to the vertical position, with palms facing, and hands shoulder-width apart.

The position expands the chest and raises the ribs. It makes a trunk exercise harder, as it raises the centre of gravity.

It is sometimes used to give the gymnast a longer lever.

**Working Muscles.** The outward rotators of the shoulder-joint; viz : infra-spinatus and teres minor, also Deltoid, the upper part of Trapezius and Serratus magnus. The muscles work concentrically to take the position and statically to hold it.

*Half Stretch Standing* (*½ Str. St.*). One arm only is raised. If the arm is stretched to its full limit, the back muscles on the opposite side of the spine come into action.

It is used in the treatment of scoliosis to raise a low shoulder and to contract the muscles on the convexity of the curve.

*Crutch Standing* (*Crutch St.*). One arm is placed over a boom level with the axilla. It is used to fix the body when giving head exercises.

*Grasp Positions* (*Grasp*). Grasping is added to certain positions to fix the patient, *e.g.* Reach grasp standing, etc.

### BY MOVING THE LEGS

*Close Standing* (*Cl. St.*). The feet touch each other along their inner border.

This is a balance position. The standing base is less than in the standing fundamental position. It is used in giving exercises to work the rotators of hips and trunk.

**Working Muscles.** All the postural muscles which work to maintain the standing position; also Tensor fasciæ femoris and the anterior fibres of Gluteus medius and minimus. The latter work first concentrically, then statically with all the others.

The muscles around the ankle-joint must all work in turn to help maintain the position.

*Toe Standing* (*Toe St.*). The heels are lifted from the ground, but are kept together. The body is supported only on the toes.

It is a balance position. The base is less than in close standing.

**Working Muscles.** Those of the calf—which are the plantar flexors of the ankle-joint, viz., Gastrocnemius and Soleus. They first work concentrically, then statically to hold the position.

*Knee-bend Standing.* The knees are bent as far as possible, but the heels kept on the ground. The knees should be well parted.

Is not much used except with toe-standing.

**Working Muscles.** The body is lowered to its position by gravity, but the groups working are the extensors of the hip, knee and plantar flexors of the ankle. The muscles respectively being the Gluteii, Quadriceps and the calf muscles. These work eccentrically to control the movement and statically to maintain the position.

*Toe Knee-bend or Curtsey Sitting* (*Curt. Sitt.*). A balance position and a combination of the two preceding positions. Beginning in fundamental standing, the patient raises on tip-toes, and then sinks into the full knee-bend standing position. The trunk is kept upright and owing to the heel-raising it can be lowered much further than in knee-bend standing.

**Working Muscles.** To raise on to the toes, the plantar flexors work concentrically, then statically. The hips and knees are flexed by gravity, but the extensors of both joints work eccentrically to take the position and statically to hold it. The back muscles work statically to keep the trunk upright.

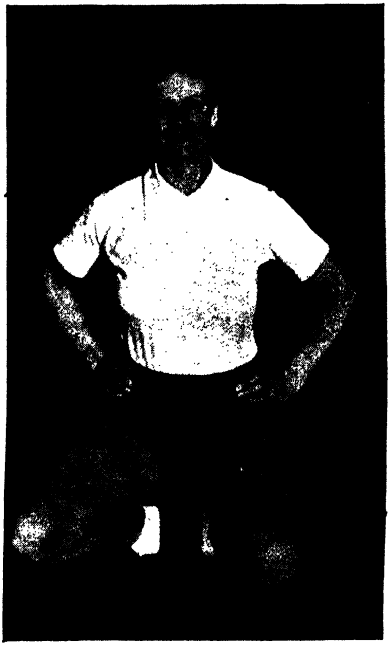

FIG. 39.—CURTSEY SITTING.

*Stride Standing* (*Std. St.*). One foot is placed sideways from the other a distance of two feet.

This is a steady position, as the standing base is enlarged sideways. It is much used.

**Working Muscles.** Abductors of the hips, and muscles around the ankle-joints work concentrically and then statically.

*Walk Standing* (*Wlk. St.*). A. Is taken by placing one foot outwards, two foot-lengths ; and Walk Standing B, one foot is placed forward, two foot-lengths.

Either are steady positions, the standing base being lengthened from before backwards. Walk B is the starting position for double-plane arm carrying.

**Working Muscles.** Flexors of the hip of the moved leg work concentrically to take the position. The extensors of the knees statically to maintain it, and in transferring the weight from the back leg, the calf muscles work concentrically.

*Fall-out Standing* (*Fall-out St.*). One foot is moved three foot-lengths either forward or backward, keeping the same angle between the feet. The trunk falls forward and the front knee is bent until it is over the toes. The trunk and the back leg must remain in a straight line. One arm is stretched, while the other is directed somewhat backwards, close to the trunk.

**Working Muscles.** A large number of muscles come into action, especially those of the back, particularly in the lumbar region on the side of the forward leg. During the holding of the position these lumbar muscles support the body-weight working statically.

The flexors of the hip, knee and dorsi flexors of the ankle of the forward leg work concentrically to begin the movement.

To maintain the position, the extensors of both hips, knees, and plantar flexors of the ankles work strongly statically.

All the back muscles work statically to maintain the position.

If the arm is stretched up on the same side as the forward leg (the other arm extended slightly backwards) the back shoulder muscles on the opposite side of the up-stretched arm work strongly.

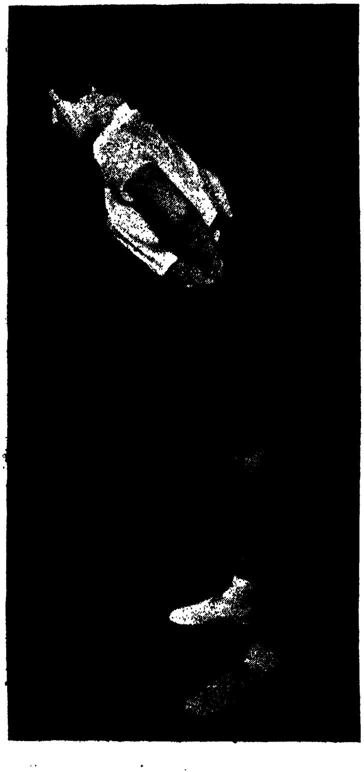

FIG. 40.—WING STRIDE STOOP STANDING.

BY MOVING THE TRUNK

*Stoop Standing* (*Stp. St.*). The trunk is allowed to fall forwards, at the hip joints, keeping the back flat.

The trunk should be carried slightly backwards from the ankle-joints, to bring the line of gravity within the base.

As an increased blood-supply is brought to the back and gluteal muscles, it is consequently depleting from the abdomen and pelvis.

**Working Muscles.** Flexors of the hips, to take the position, work concentrically, but as soon as the line of gravity falls in front of the hip-joints the hip extensors come into action, working eccentrically.

To hold the position there is strong static work for hip extensors and back muscles. The dorsi flexors of the ankle work eccentrically.

*Stoop Leg Lean Standing* (*Stp. Leg Lean St.*). The same as stoop standing, except the thighs lean against a boom or support. It makes the position steadier. It is used for strong back raisings and plane arm carrying.

*Lax Stoop Standing* (*Lax Stp. St.*). The trunk falls forwards and downwards. The hip-joints and the lumbar spine are flexed.

The position taken by a patient when the operator examines for scoliosis.

*Fall Standing* (*Fall St.*). The body falls backwards against some support.

Sometimes used for giving double-plane arm carrying.

*Side Bend Standing* (*S. Bd. St.*). The trunk is bent to one side. The flexion should take place as high up as possible, and there must be no twisting.

The position compresses the thorax on the bending side, and expands the opposite side. It is especially used in the after-treatment of pleurisy, and other chest conditions.

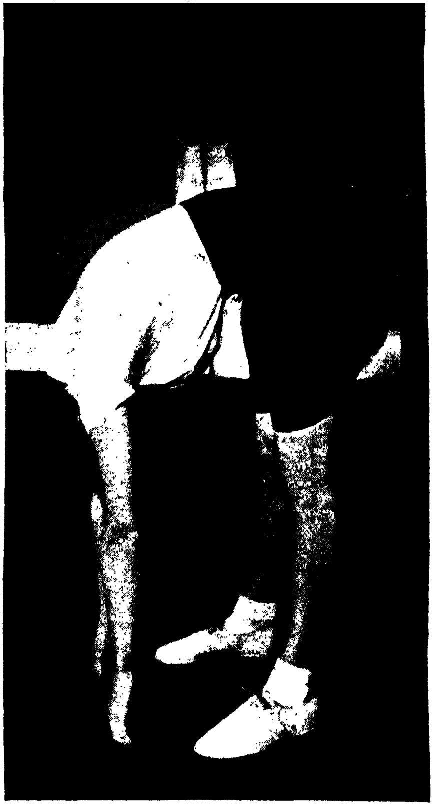

FIG. 41.—STRIDE LAX STOOP STANDING.

**Working Muscles.** On the side towards which the movement is done, those muscles lying lengthwise both on the back and front, first work concentrically until the line of gravity falls to the side.

Then the same muscles on the opposite side work eccentrically and then statically. The side flexors are: the abdominal muscles, erector spinæ, and quadratus lumborum of one side.

*Turn Standing* (*Turn St.*). The trunk is turned to one side as far as possible. The head and shoulders must remain as in fundamental standing, but the pelvis is turned.

The position is important for starting rotation exercises for the trunk and pelvis.

**Working Muscles.** Certain groups are called rotators of the trunk, others rotators of the pelvis.

The left rotators of the trunk on the front of the body are: Left Internus obliquis abdominis and right External obliquis abdominis.

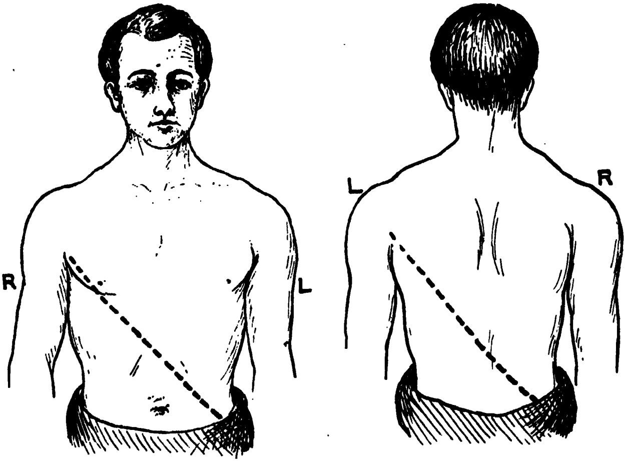

FIG. 42.—SHOWING THE DIRECTIONS OF THE LEFT ROTATORS OF THE TRUNK.

These are passing from below on the left obliquely up towards the right.

The left rotators on the back of the body are: the left ilio costalis, right serratus posticus superior, left serratus posticus inferior, right rototores, left splenius capitis.

The parts of these muscles acting in left rotation pass from the right side below, and up obliquely to the left.

When a left trunk rotation is done, the lower border of the right side of the thorax comes nearer to the left anterior superior iliac spine.

The left rotators of the pelvis are: the inward rotators of the left hip, viz., the anterior part of Gluteus medius and minimus, and the outward rotators of the right hip, viz., Obturator internus and externus, the Gemelli, Quadratus femoris, and Pyriformis.

In rotating to the right, the muscles work in the opposite direction.

## Derived Positions from the Sitting Fundamental Position

### By Moving the Arms

These are the same as in Standing.

### By Moving the Legs

*Long Sitting* (*Lg. Sitt.*). The patient sits with legs fully extended and supported from the hips to the ankles. The trunk must be at right angles to the thigh.

The position stretches the hamstring muscles and the lumbar spine.

**Working Muscles.** To take the position the Quadriceps work concentrically. To maintain it the flexors of the hips and the spinal muscles work statically. The abdominal and pre-vertebral muscles also work statically to help maintain a good posture.

*Half-sitting* (*½-sitt.*). One thigh is supported on a plinth from hip to knee, while the other hangs down.

It is used to give a movement in one knee only.

*Stride Sitting* (*Stri. Sitt.*). The feet are placed apart a distance of two feet. A right angle between the thigh and lower leg must be maintained. It is a steady position and much used.

**Working Muscles.** The abductors of the hip-joints, viz., Gluteus medius, minimus and tensor fasciæ femoris work concentrically to take the position and statically to maintain it.

A steady position.

*Ride Sitting* (*Ride Sitt.*). The patient sits astride a stool or chair.

A still steadier position.

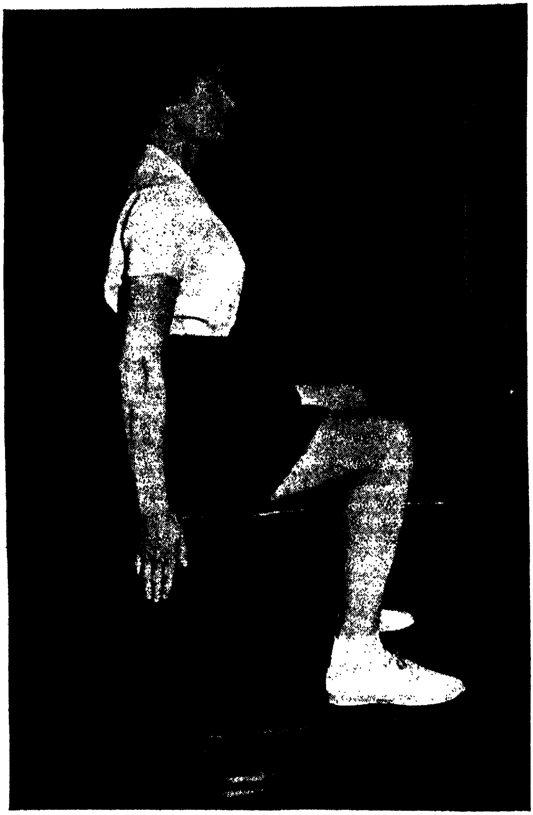

FIG. 43.—HIGH RIDE SITTING.

*High-ride Sitting* (*High Ride Sitt.*). This is the same as ride sitting, only it is done upon a high plinth. The feet may here be fixed by straps, making the position a very steady one.

BY MOVING THE TRUNK

*Stoop Sitting* (*Stp. Sitt.*). The trunk falls forward at the hip-joints, keeping the back flat.

*Lax Stoop Sitting* (*Lax Stp. Sitt.*). The trunk falls forwards, allowing the whole back to relax.

*Turn Sitting* (*Turn Sitt.*). The trunk is turned to the right or left.

*Fall Sitting* (*Fall Sitt.*). The trunk falls backwards from the hips. Feet or knees must be fixed.

**Working Muscles.** To take the position the hip flexors work eccentrically and then statically to hold it.

If the feet are fixed the dorsi flexors work statically.

If the knees are fixed their extensors work statically.

The abdominal muscles and those on the front of the neck also work statically.

*Spring Sitting* (*Sp. Sitt.*). This is like fall-out standing, but differs from it, as the thigh of the forward leg lies horizontally on a stool. The other leg is stretched back as far as possible. The arms may be in wing, neck firm, or stretch position, according to the result required.

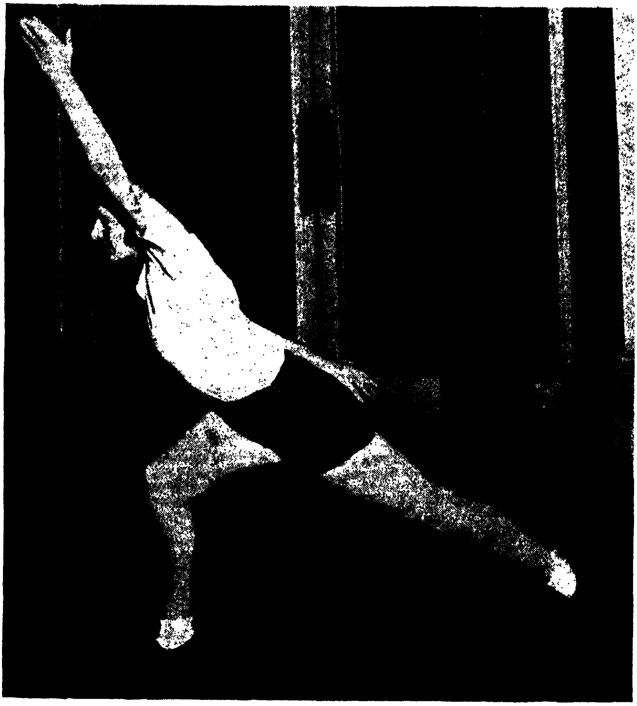

FIG. 44.—SPRING SITTING.

**Working Muscles.** Are much the same as in Fall-out Standing, see p. 83.

## Derived Positions from the Lying Fundamental Position

### BY MOVING THE ARMS

*Wing or Hips Firm* } *Lying.*
*Neck Rest*
*Stretch*

### BY MOVING THE LEGS

*Crook Lying* (*Crk. Ly.*). The patient lies with the knees drawn up, and the feet upon the plinth.

**Working Muscles.** To take the position, the hip joints are flexed by Psoas and Iliacus, Rectus femoris, Pectineus and Sartorius—and the knees by the hamstring muscles and by Popliteus and Gastrocnemius.

*Sit Lying* (*Sitt. Ly.*). From the sitting position (generally with hips firm) the patient falls back until his head touches the support. The legs hang down at right angles to the thighs.

**Working Muscles.** Gravity carries the trunk down, while the hip flexors work eccentrically and the abdominal muscles statically.

### BY MOVING THE TRUNK

*Half-lying* (*½-ly.*). The patient takes the position on a plinth or bed, so that the body is at an angle half-way between sitting and lying. The feet rest on the floor, or are supported. This position is much used. It is the true position of rest, as every part of the body as far as possible is half-way between the extremes of each position. The longest end of the plinth is raised for this position.

*Crook Half-lying* (*Crk. ½-ly.*). This is the same as half-lying, only the legs are drawn into the hook position. The abdominal muscles are relaxed, and this is the position used for giving abdominal massage. The shortest end of the plinth is usually raised for this position.

*Forward or Prone Lying* (*Pr. Ly.*). The patient lies face downwards.

*Wing Leg Forward Lying* (*Wg. Leg Pr. Ly.*). This position is taken upon a high plinth. The patient again lies face downwards, but the legs are the only part of the body which is supported. The trunk projects over the edge of the plinth. The legs must be firmly fixed by a strap, or be held by a second gymnast. The patient first kneels so that the distance from the knees to the edge of the plinth is the same as that from the iliac crests to the knees. The patient's hands first rest upon the gymnast's shoulders and the latter supports well under the arms. The patient then flexes the hips and falls forward into a horizonal position.

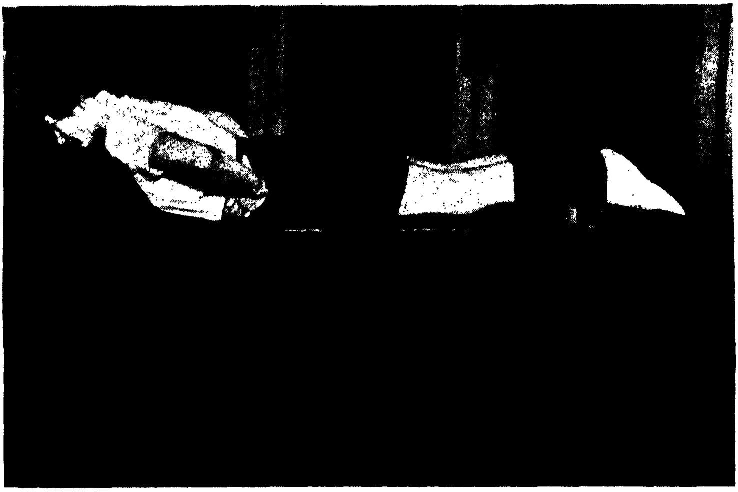

FIG. 45.—WING LEG FORWARD LYING.

**Working Muscles.** To maintain the position all the muscle groups on the back of the body work statically, viz., the extensors of hips, and the back and neck muscles.

# CHAPTER X

PASSIVE MOVEMENTS :—In upper extremity—Fingers—Thumb—Wrist —Radio-ulnar—Elbow—Shoulder—Lower extremity—Foot and ankle—Knee—Hip—Head and neck.

*Note.* In the following chapters describing passive, assisted and resisted exercises, the model is termed the 'patient,' and the operator the 'gymnast.'

## Passive Movements

PASSIVE movements are those performed in a patient's joints (by an operator), without volition by the patient.

*The Effects and Uses are* :—

1. To increase mobility in the joints. This is sometimes a necessity after injuries. In such cases ligaments and soft tissues are stretched, adhesions broken down, or their formation prevented.
2. The circulation in the veins is helped. The movements cause an alternate lengthening and shortening of the vessels and the blood within them is pressed on towards the heart.

## Passive Movements in the Upper Extremity

*Position.* For the patient, sitting. For the gymnast, also sitting, but she should be higher than the patient.

### FINGER-JOINTS

*Finger Rolling.* The gymnast supports the elbow on her knee. The metacarpo-phalangeal joints are fixed by one hand, and the tops of the fingers grasped with the other. The fingers are carried in large circles in both directions. 6 to 12 times.

*Finger Flexion and Extension.* The Position and Holding are the same as those for rolling, but the gymnast places all the fingers of one hand over the patient's fingers.

Passively, she flexes the fingers into the hand, raises them up again, and gives an over-stretching. 6 to 12 times.

### THUMB-JOINT

*Thumb Rolling.* The gymnast fixes the carpo-metacarpal joint with one hand, and with the other carries the thumb in large circles in both directions. 6 to 12 times.

*Thumb Flexion and Extension.* As for the fingers. 6 to 12 times.

*Thumb Abduction and Adduction.* The holding the same as that for rolling ; the thumb is alternately carried to the side of the hand, and abducted as far as possible. 6 to 12 times.

*Opposition of Thumb.* It is carried across the palm and back again.

Passive movement performed individually in every joint of the fingers and thumb is sometimes necessary to increase mobility in old-standing cases after injuries. The hand is then supported horizontally and each joint held with one hand, while the movement is done with the other. 10 to 40 times.

### WRIST-JOINT

*Wrist Rolling: Positions.* The same as for finger rolling, or with the forearm lying horizontally and supported.

The gymnast holds the patient just above the wrist with one hand, and with the other over the metacarpo-phalangeal joints. With the latter hand she carries the wrist in circles, as large as possible, in both directions, but the wrist being a condyloid joint, it is impossible to perform a perfect circumduction. 6 to 12 times.

*Wrist Flexion and Extension or Volar and Dorsal Flexion.* The position and grasp are the same as for rolling. Passively, the gymnast carries the hand alternately to full flexion and extension, giving a slight tension upwards of the joint all along. 4 to 8 times.

*Radial and Ulnar Flexion.* The position and grasp are the same as for rolling. The gymnast carries the hand alternately towards the radial and ulnar borders of the wrist, also giving some tension upwards. There is much less radial than ulnar flexion in a normal wrist-joint. The movement must be kept purely lateral throughout. 4 to 8 times.

## SUPERIOR AND INFERIOR RADIO-ULNAR-JOINTS

*Pronation and Supination.* The patient's forearm rests horizontally upon a table or firm pad. The gymnast stands and grasps the patient's hand, as if shaking hands. Right hand with right, and left with left. The opposite hand grasps the patient's wrist (this holding is specially used for injured wrists), or supports the elbow.

The gymnast alternately pronates and supinates the forearm. If the first holding is used, the gymnast's supporting hand moves round with the patient's. The joint must be kept fully extended, and no twisting is allowed. 4 to 8 times.

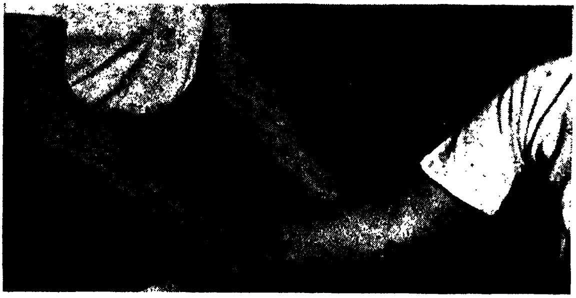

FIG. 46.—THE HOLDING FOR PRONATION AND SUPINATION.

## ELBOW-JOINT

*Elbow Flexion and Extension.* The patient's elbow lies within the gymnast's hand upon the table, close to the edge. The gymnast stands, and with her other hand grasps the patient's wrist. (Holding with right hand, for patient's right arm.)

The gymnast fully flexes and extends the forearm, giving a slight over-stretching at the beginning and end. 6 to 12 times.

## SHOULDER-JOINT

*Position.* For the patient, sitting, ½-lying or lying. The gymnast stands at the side, her feet well parted.

*Circumduction or Arm Rolling.* If giving movement to the right arm, the gymnast allows the patient's forearm to lie along her own (right), and she supports the inner side of the elbow. Her left hand supports the outer side of the same joint. The arm is carried in large circles in both directions. 6 to 12 times.

If there has been any injury near the shoulder-joint, it is sometimes well to place the left hand over the (right) shoulder to fix it (fingers in front, thumbs behind).

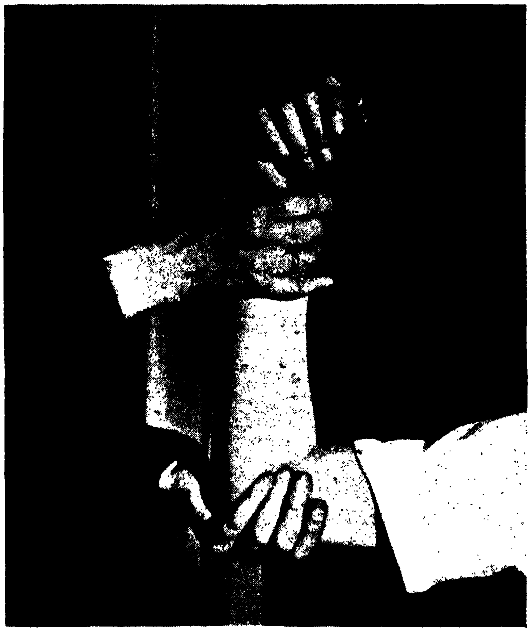

FIG. 47.—HOLDING FOR ARM ROTATION.

*Abduction and Adduction.* The position and holding are the same as for rolling.

The gymnast raises the arm to a horizontal line with the shoulder, and then carries it back to the side of the body. 4 to 8 times.

*Flexion and Extension.* If giving movement to the right arm, the gymnast holds the patient's wrist with her left hand, and supports the flexed elbow with her right.

The gymnast carries the arm forwards and backwards as far as possible, or across the chest and then backwards. 4 to 8 times.

*Rotation.* The gymnast takes the same holding as for flexion and extension, but the arm is kept in the abducted position, and the forearm at right angles to the upper arm.

The gymnast turns the arm downwards and upwards. 4 to 8 times.

## Passive Movements in the Lower Extremity

*Toe Rolling : Positions.* For the patient, lying, ½-ly. or sitt. The gymnast sits or stands. She fixes the metacarpo-phalangeal joints with one hand, and with the other grasps the toes and carries them in a circle 6 to 12 times in each direction.

*Toe Flexion and Extension.* The position and holding is the same as for rolling, the toes are alternately flexed and extended, the gymnast giving an over stretching at the end of the movement.

*Toe Abduction and Adduction.* A sideways movement in each direction is made as far as possible. Used chiefly for the big toe.

### FOOT AND ANKLE

*Foot Rolling : Positions.* (*a*) For the patient, sitting or ½-ly. The gymnast sits in front of, rather lower, and to the outer side of the patient. She takes the patient's foot upon her knee, allowing the heel to be over the edge. (*b*) The patient lying, the foot and leg supported on a firm pad, with the heel over the edge.

With the hand nearest the patient the leg is firmly held above the ankle. The outer hand holds the foot, and carries it in large circles in both directions. At the end of the rollings, the foot is strongly pressed into dorsal flexion 6 to 12 times.

*Note.* The student should bear in mind that the ankle is a hinge-joint, and this rolling can only take place as a combined movement in the ankle and tarsal joints. It is therefore incorrect to speak of ankle rolling.

*Foot Flexion and Extension, or Dorsal and Plantar Flexion.* The positions are the same as for rolling. The gymnast places one hand on the dorsal surface, the other on the plantar.

The foot is carried to flexion and extension, ending with flexion and a strong pressure. 4 to 8 times.

*Inversion and Eversion, or Supination and Pronation of* *the Foot.* The positions are the same as for rolling. The gymnast grasps the patient's foot with both hands, beginning with the thumbs upon the dorsal surface, the fingers on the plantar. She turns the outer border of the foot towards the centre, at the same time trying to increase the concavity along the inner border of the foot, which is then in the position of inversion. She then changes the holding, and allows the fingers to be on the dorsal surface, the thumb below. She now turns the outer border of the foot out as far as possible. It is then in the position of eversion. 4 to 8 times.

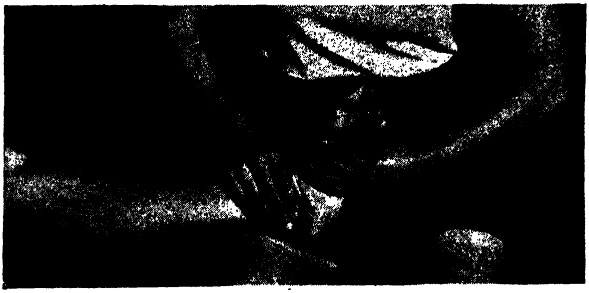

Fig. 48.—Holding for Inversion and Eversion of Foot.

## KNEE-JOINT

*Flexion and Extension: Position.* (*a*) For the patient, sitting. The gymnast sits at the side, and places her own knee under that of the patient. The gymnast places her hand nearest the patient above the knee and fixes it, with the other hand she grasps above the ankle.

The gymnast carries the lower leg to full extension, then back to flexion, pressing the limb against her own. In this way flexion can only be carried to a little less than the right angle. 4 to 8 times.

*Position.* (*b*) For the patient, lying. The gymnast stands at the side, and with the hand nearest the patient grasps round the thigh above the knee, holding the hip flexed to a right angle.

The gymnast grasps the ankle, and alternately flexes and extends the knee to its full limit. 4 to 8 times.

*Note.* This position is not always satisfactory, on account of the unfixed position of the hip-joint.

*Position.* (*c*) The patient lies prone.

The gymnast stands at the side, and alternately flexes and extends the knee. The fullest flexion can be obtained in this position. 4 to 8 times.

*Knee-pumping.* This is the same as knee flexion and extension in position *a*, but it is performed quickly and is always a passive movement. 8 to 20 times.

*Internal and External Rotation.* When the knee-joint is in a flexed position, a small amount of internal and external rotation is possible. This may be attempted in the same position as above, the gymnast fixing the joint with one hand and performing the movement by grasping the patient's leg with the other, above the ankle.

## HIP-JOINT

*Position.* For the patient, lying or ½-lying. The gymnast stands at the side.

*Circumduction or Rolling.* The gymnast supports behind the knee, with the hand nearest the patient. With the opposite hand she holds the foot, grasping the heel, and letting it lie in the palm of her hand.

Part of a circle is then described with the knee. It is first carried up towards the shoulder, then allowed to fall outwards in a large semi-circle, and brought back to the starting-point. The knee should remain flexed throughout the rolling. 6 to 18 times.

The rolling is usually done in an outward direction only. It is also given by carrying the limb in small circles round a large one. This is done in both an outward and inward direction, and is used chiefly to increase mobility in the hip-joint. 4 to 6 times.

The rolling may also be given in large circles, swinging the knee strongly against the shoulder. This form is chiefly used in the treatment of constipation. It exercises pressure against the abdomen, and stimulates the organs. 4 to 8 times.

*Flexion and Extension.* The position and holding are the same as for rolling.

The leg is alternately flexed and extended by the gymnast, movement taking place both in the hip and knee. Considerable pressure may be exerted by the gymnast upon the leg, when it is fully flexed. 4 to 8 times.

*Abduction and Adduction.* The position is the same as for rolling, but the foot is supported on the couch with the knee well flexed. The gymnast places her hands one each side of the knee-joint, and passively carries the thigh to the abducted position, and back to the mid-line. 4 to 8 times.

*Rotation.* The position is the same as for rolling, but the movement can be given in two ways.

(*a*) The patient lies with the leg fully extended. The gymnast grasps the foot with both hands, and passively turns it alternately in and out, giving some downward traction all the time. 4 to 8 times.

(*b*) The gymnast flexes the hip to a right angle, and holds it there by grasping round the knee with one hand. With the other she alternately turns the lower leg in and out. 4 to 8 times.

## Passive Movements of the Head and Neck

THE movements take place in the joints of the cervical vertebræ and also between atlas and the occipital bone.

They are performed round three axes, *viz* :—

Frontal for flexion and extension.
Sagittal for side-bending.
Vertical for turning or rotation.

*Positions.* Lying (head over end of plinth).
Sitting (Rch. gr.).
Standing (Rch. gr.).

*Head Rolling.* The gymnast stands at the side and grasps the patient's head on each side with a wide grasp. The patient must relax the muscles as much as possible.

The head is carried in large circles, forward, to the right, back, left and forward again. 4 to 12 times. This is repeated in the opposite direction. There must be no twisting during the movement.

*Head Flexion and Extension, i.e. Bending Forwards and Backwards.* The gymnast stands at the side, grasps the head in the same way as for rolling, and carries the head forwards and backwards giving upward traction as she does the movement. 4 to 8 times.

*Head Flexion Sideways* or *Head Side Bending.*

The gymnast grasps on each side and bends the head sideways as far as possible and raises it to the midline giving upward traction. 4 to 8 times.

*Head Rotation* or *Head Side Turning.* The position and holding is the same as the last. The head is turned to right and left as far as possible giving upward traction. 4 to 8 times.

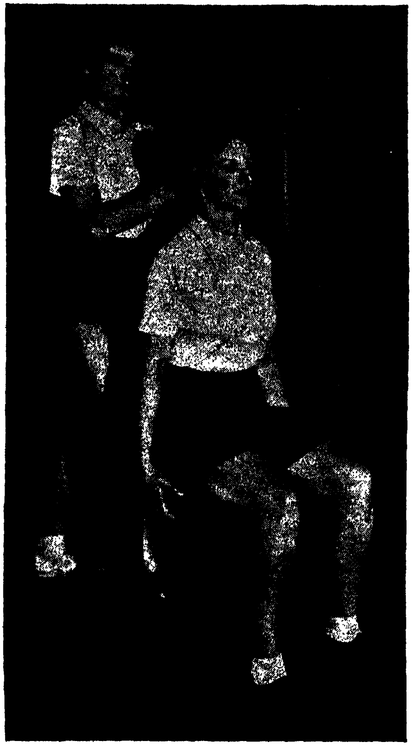

FIG. 49. HOLDING FOR HEAD SIDE BENDING AND TURNING.

*Traction of the Head.* This is given when an extra stretching is required in the neck region.

The patient lies with the head over the end of a plinth.

The gymnast grasps the head. (*a*) One hand beneath the chin, the other in the occipital region. (*b*) A hand on each side of the head.

Stretching the neck in this way may be given to an infant with a slight torticollis, when exercises are not possible. The child lies on the mother's knee, or is held by an assistant.

Traction may be done for from ¼ to ½ a minute. A head suspension apparatus may also be used.

## Passive Trunk Movements

Certain passive trunk movements were formerly taught but are not now used. Their place is taken by various types of free trunk and breathing exercises.

# CHAPTER XI

ACTIVE MOVEMENTS :—Assisted—Free—Resisted—Concentric—Eccentric—Static—Uses of various kinds of muscle work—Effects and uses of active movements—Practical hints—Table writing—Suggested order of exercises.

## Active Movements

Active movements are those performed by the voluntary effort of the patient. They may be :—

*Assisted, i.e.* done with some help, as in the treatment of early injuries (see p. 172).

*Free, i.e.* done by the patient alone.

*Resisted, i.e.* resistance is given by another person, and is used to increase the strength of the movement, or it may be applied to make a certain group or groups of muscles work in a particular way. In remedial gymnastics resisted active movements are classified according to their muscle work as concentric and eccentric movements.

*Concentric Muscle Work.* The gymnast holds the patient's limb, and tells the latter to perform a movement. While this is done, the gymnast gives resistance, little or much according to circumstances. While this movement takes place, the origin and insertion of the working muscle are getting nearer to each other, and the muscle becomes thicker in the centre. The patient does the movement, the gymnast resists.

*Eccentric Muscle Work.* The gymnast again holds the patient's limb, but she performs the movement, telling the patient to resist. While this takes place, the origin and insertion of the working muscle are drawn farther apart, and the muscle is becoming longer. The gymnast does the movement, the patient resists.

In some cases eccentric work takes place when the weight of the body or part of it is a factor in performing a movement. Examples of this will be seen in the free exercises given in a later chapter.

*Static Muscle Work.* No movement is performed, but if a limb or any part of the body is placed in position, the muscles work statically to keep that position.

*The Uses of Concentric, Eccentric, and Static Muscle Work.* Concentric work is most frequently used; it is given to muscle groups which work antagonistically to each other, *e.g.* flexion and extension, and used to strengthen equally both groups of muscles.

Eccentric work is generally combined with concentric, and used in this way only one muscle group is exercised. In certain conditions the extensors are weaker than the flexors, and by giving concentric and then eccentric work to the extensors, this group only is exercised, and the flexors remain passive.

This kind of muscle work is used for recovering paralysis and in the treatment of deformities.

Static work increases the strength of the muscles for which it is given.

### *Effects and Uses of Active Movements*

1. The supply of blood to the working muscles is increased, and therefore their nutrition is improved.
2. The muscles develop and grow stronger.
3. Mobility in the joints is increased.
4. The circulation in the veins is improved.
5. The contractions of the heart become stronger.
6. The nervous system is stimulated.
7. The process of metabolism is increased.

## PRACTICAL HINTS ON GIVING MOVEMENTS AND EXERCISES

It is essential that the patient's position should be comfortable, and support given to the limb or limbs when necessary.

The gymnast may stand or sit, but her position must be as firm and comfortable as possible.

All grasps must be taken with a broad flexible hand. The patient should never feel pinched or hurt.

The gymnast must avoid pressing a joint down, but give a gentle traction upwards.

Resistance when given should be very regular, and should last from the beginning to the end of a movement.

The gymnast modifies her resistance, according to the patient's strength. The movement should never be a struggle between the two.

The gymnast tells the patient what he is required to do, saying, *e.g.*, bend, stretch, lift up, drawn down, resist, etc.

## GYMNASTIC TABLE WRITING

A table, scheme or prescription of exercises is a list written by the gymnast, and performed by the patient at each treatment.

The doctor's diagnosis must be considered and the following points noted :—

1. The patient's age and condition.
2. In general treatment, exercises must be given for all parts of the body.
3. In special treatment, exercises are also added to affect the special condition.
4. The patient should not be over-tired. Rest after treatment is often necessary.
5. Similar exercises should not immediately follow each other.
6. The exercises must be arranged so that the strongest ones are in the centre of the table.

## SUGGESTED ORDER OF EXERCISES

1. Breathing exercise.
2. Extremity movements (arms or legs, or both).
3. Exercise or manipulations to affect the abdomen.
4. Head and neck (sometimes omitted).
5. Chest.
6. Back.
7. Extremities.
8. Breathing exercise.

*Note.* Breathings are often inserted in other parts of the table besides those mentioned above.

Movements for special conditions are also added.

# CHAPTER XII

ASSISTED AND RESISTED ACTIVE MOVEMENTS :—UPPER EXTREMITY—Fingers—Thumb—Wrist—Elbow—Shoulder—Shoulder girdle—Active movements with concentric work—Free movements—Resisted arm exercises—Free arm exercises—Combining arm and trunk movement.

## Assisted and Resisted Active Movements

**It is assumed that the student has already learnt the various *holdings* by first practising the movements passively. These remain the same, but now the gymnast gives an order, the patient carries it out: The gymnast has also to assist and resist according to requirements. The terms concentric and eccentric are abbreviated to con. and ecc.**

## UPPER EXTREMITY

### FINGER-JOINTS

### For Flexors and Extensors

*Flexion.* The patient flexes the fingers into the hand. The gymnast resists, then brings the fingers to starting position, the patient resisting.

**Muscles Working Con. and Ecc.** (*a*) In the metacarpo-phalangeal joints—Flexores sublimis and Profundus digitorum ; also the Lumbricales and Interossei.

(*b*) In the inter-phalangeal joints—Flexores sublimis and Profundus digitorum.

(*c*) In the most distal joints—only Flexor profundus digitorum.

*Extension.* After a passive flexion. The patient stretches the fingers, the gymnast resisting. The gymnast then presses the fingers into the hand, the patient resisting.

**Muscles Working Con. and Ecc.** In the metacarpo-phalangeal joints—Ext. Communis digitorum. In the inter-phalangeal joints—Lumbricales and Interossei.

### For Abductors and Adductors

*Abduction.* The patient spreads his fingers (joints extended) the gymnast resisting. The gymnast closes them, the patient resisting.

**Muscles Working Con. and Ecc.** The abductors, viz., the Dorsal interossei, and, for the little finger, the abductor and flexor brevis minimi digiti.

*Adduction.* The patient closes his fingers (joints extended), the gymnast resisting. The gymnast attempts opening them, the patient resisting.

**Muscles Working Con. and Ecc.** The adductors, viz., the Palmar interossei.

## THUMB-JOINT

### For Flexors and Extensors

*Flexion.* The patient flexes the thumb into the hand, the gymnast resisting. The gymnast draws it out to full extension, the patient resisting.

**Muscles Working Con. and Ecc.** Flex. longus and Brevis pollicis.

*Extension.* After a passive flexion, the patient extends the thumb, the gymnast resisting. The gymnast presses the thumb into the hand, the patient resisting.

**Muscles Working Con. and Ecc.** Extensor longus and Brevis pollicis and Abductor longus pollicis.

### For Abductors, Adductors and Opposers

*Abduction.* The extended thumb is carried away at 90 degrees with the palm of the hand by the patient, the gymnast resisting. The gymnast returns the thumb to the adducted position, the patient resisting.

**Muscles Working Con. and Ecc.** Abductor longus and Brevis pollicis, assisted by extensors.

*Adduction.* Starting from abduction the patient draws the thumb to beside the index finger, the gymnast resisting. The gymnast draws out the thumb, the patient resisting

**Muscles Working Con. and Ecc.** Transversus and obliquis pollicis and thumb adductors.

*Opposition.* The thumb is drawn across the palm by the patient, the gymnast resisting. The gymnast draws it out, the patient resisting.

**Muscle Working Con. and Ecc.** Opponens pollicis.

## WRIST-JOINT

### For Flexors and Extensors

*Flexion.* The grasp is the same as for rolling. The patient flexes the wrist, the gymnast resisting. The gymnast carries it back to full extension, the patient resisting.

**Muscles Working Con. and Ecc.** The anterior forearm muscles, viz., Flex. carpi radialis, Flex. carpi ulnaris, Flexores sublimis and Profundus digitorum.

*Extension.* The patient extends the wrist as far as possible, the gymnast resisting. The gymnast carries it back to full flexion, the patient resisting.

**Muscles Working Con. and Ecc.** Extensores carpi radialis longus and brevis, Ext. carpi ulnaris, Extensores digitorum and indicis.

### For Abductors and Adductors

*Abduction or Radial Flexion.* The grasp is the same as for rolling. The patient bends the wrist to the radial side, the gymnast resisting. The gymnast carries it back to full ulnar flexion, the patient resisting.

**Muscles Working Con. and Ecc.** Flexor carpi radialis, also Extensor carpi radialis longior and brevior.

*Adduction or Ulnar Flexion.* The patient bends the wrist to the ulnar side, the gymnast resisting. The gymnast carries it back to full radial flexion, the patient resisting.

**Muscles Working Con. and Ecc.** Flexor carpi ulnaris and extensor carpi ulnaris.

*Note.* There is much less radial than ulnar flexion in a normal wrist-joint. The movement must be kept purely lateral throughout.

## SUPERIOR AND INFERIOR RADIO-ULNAR JOINTS

### For Pronation and Supination

*Pronation.* The patient's forearm rests horizontally upon a table or firm pad. The elbow is bent. The gymnast stands and grasps the patient's hand as if shaking hands. Right hand with right, and left with left. The gymnast's opposite hand supports the elbow.

The patient turns in (pronates) the hand as far as possible, the gymnast resists. The gymnast turns the hand back to full supination, the patient resisting. The wrist joint must be kept fully extended. (See Fig. 46).

**Muscles Working Con. and Ecc.** Pronator radii teres and Pronator quadratus.

*Supination.* The holding is unchanged. Starting from the pronated position the patient turns the hand out as far as possible, the gymnast resisting. The gymnast carries it back to full pronation, the patient resisting.

**Muscles Working Con. and Ecc.** Supinator brevis, Biceps, and Brachio-radialis (at the beginning only).

## ELBOW-JOINT

### For Flexion and Extension

*Flexion.* The patient's elbow lies within the gymnast's hand upon a table, close to the edge. The gymnast stands (on outer side) and with the opposite hand grasps the wrist. Fingers lying upon palmar surface of the joint. The wrist is kept extended.

The patient flexes the elbow, the gymnast resists.

The gymnast draws the arm out to starting position while the patient resists.

**Muscles Working Con. and Ecc.** Biceps, Brachialis anterior and Brachio-radialis.

*Extension.* The position and holding, the same.

Starting with the joint fully flexed, the patient extends the elbow, the gymnast resisting. The gymnast carries the arm to starting position, the patient resisting.

**Muscles Working Con. and Ecc.** Triceps and Anconeus.

## THE SHOULDER-JOINT

### For Abduction and Adduction

*Abduction.* The position for the patient—sitting, lying or half-lying. For the gymnast—standing or sitting. The holding is the same as for rolling, *i.e.* the gymnast allows the patient's forearm to lie along her own (right) and she supports the inner side of the elbow. Her left hand supports the outer side of the joint. The patient raises the arm till it is horizontal with the shoulder, the gymnast resisting. The gymnast carries the arm back to the starting position, the patient resisting.

**Muscles Working Con. and Ecc.** Deltoid and Supra-spinatus.

*Adduction.* The holding is the same. Starting from abduction, the patient draws the arm to the side of the body, the gymnast resisting. The gymnast attempts raising the arm to abduction, the patient resisting.

**Muscles Working Con. and Ecc.** Pectoralis major, Lat. dorsi, Teres major.

*Note.* Abduction and adduction may also be given with a straight elbow.

### For Flexion and Extension

*Flexion.* The holding is the same as for rolling, *i.e.* if giving the movement to the right arm, the gymnast holds the patient's wrist with the left hand and supports the flexed elbow with her right.

The patient carries the arm forwards as far as possible the gymnast resisting. The gymnast takes it back to the starting position the patient resisting.

The movement may also be done carrying the arm across the chest as far as possible.

**Muscles Working Con. and Ecc.** Pectoralis major, the anterior fibres of Deltoid, Coraco-brachialis and Biceps.

*Extension.* The holding is the same. The patient carries the arm backwards as far as possible, the gymnast resisting. The gymnast takes it back to starting position, the patient resisting.

**Muscles Working Con. and Ecc.** Extension or drawing the arm backwards by posterior fibres of Deltoid, the long head of Triceps, Latissimus dorsi and Teres major.

*Note.* Flexion and extension may also be given with a straight elbow.

### For Inward and Outward Rotation

*Inward Rotation.* The holding is the same as for flexion, but the arm is kept in the abducted position, and outwardly rotated, and the forearm at right angles to the upper arm. The patient turns the forearm forward and down, the gymnast resisting. The gymnast raises it to starting position, the patient resisting. (See Fig. 47).

**Muscles Working Con. and Ecc.** Subscapularis, Teres major and Lat. dorsi.

*Outward Rotation.* The holding is the same, but starting from the furthest point of inward rotation, the patient raises the arm upwards and backwards, the gymnast resisting. The gymnast carries it back to starting position, the patient resisting.

**Muscles Working Con. and Ecc.** Infra-spinatus and Teres minor.

*Note.* If, owing to injury the arm cannot be abducted, rotation may be done with a straight arm, the gymnast supporting at the shoulder, and urging the patient to turn in and out.

## THE SHOULDER-GIRDLE

### For Elevation and Depression

Movements in the acromid-clavicular and sterno-clavicular joints come into action with the shoulder-joint in several ways.

*Elevation. Positions.* Sitting, standing, lying. The patient raises the shoulders as high as possible (shrugging).

**Muscles Working Con. and Ecc.** Levatores scapulæ, upper fibres of Trapezius, and Sterno-mastoid.

*Depression.* The shoulders are allowed to fall by their own weight, but may also be actively depressed.

**Muscles work Con. (very slight).** Sub-clavius and Pectoralis minor.

### For Rotation of Scapula

*Lateral and Medial Rotation of the Scapula.* Positions. Yard and stretch—standing, sitting, lying.

*Lateral Rotation.* From the yard position, the arm is carried to stretch by the patient, the gymnast resisting. The arm is carried back to yard position by the gymnast, the patient resisting.

**Muscles Working Con. and Ecc.** Serratus anterior.

*Medial Rotation.* Starting in stretch position, the patient carries the arm to yard, the gymnast resisting. The gymnast carries it back to stretch, the patient resisting.

**Muscles Working Con. and Ecc.** Rhomboids and middle fibres of Trapezius.

Lateral rotation of the scapula and elevation of the shoulder is a combined movement.

Medial rotation of the scapula and depression of the shoulder is also a combined movement.

## Concentric Muscle Work for all Groups

**All the above arm movements may be done with concentric muscle work only; giving equal activity of flexors and extensors, abductors and adductors, etc. The patient does the movement, the gymnast resists. Commands are given by the gymnast, *e.g.* bend, stretch, raise up, draw down, etc.**

## Free Arm Movements

All the above movements may also be performed freely by the patient according to instruction by the gymnast. The muscle work is mainly concentric, but when gravity tends to cause the movement, eccentric work is necessary for control.

## Resisted Arm Exercises

***Half wing, half yard sitting, arm rotation with staff.*** **The patient grasps the rod in the centre (dorsum of hand uppermost). Gymnast holds staff lightly at each end, but gives a gentle traction outwards and a slight resistance. Patient turns hand in and outwards. Repeat 4 to 6 times.**

FIG. 50.—ARM ROTATION WITH STAFF.

**Muscles Working Concentrically.** For inward rotation—Subscapularis Teres major, and Latissimus dorsi. For outward rotation—Infraspinatus and Teres minor.

*Double-plane Arm Carrying.* The exercise may be done in the following positions :—

Yard walk standing.

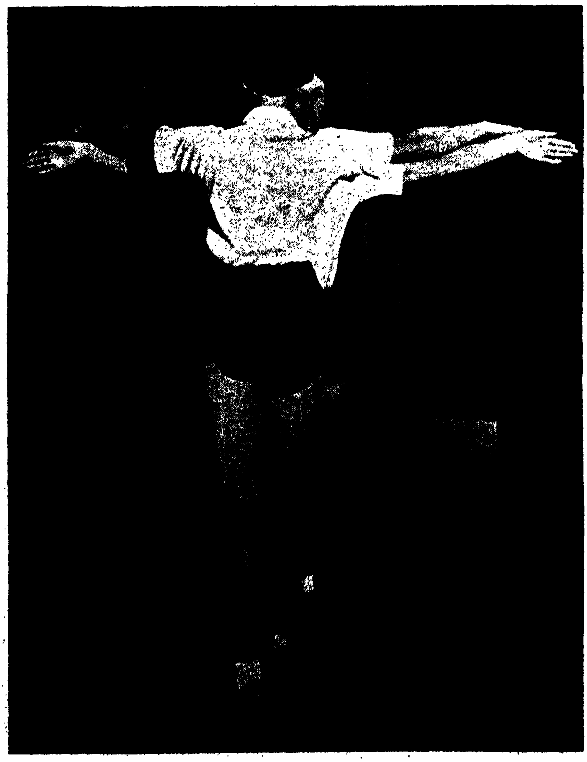

FIG. 51.—YARD WALK STANDING, DOUBLE-PLANE ARM CARRYING.

Yard-stoop-stride-standing.
Yard-fall-standing.
Yard leg lean standing.

The patient takes a suitable starting position, the palms facing forwards. The gymnast stands in front in walk standing and lightly grasps just above the patient's wrist (either from above or below, according to the height of the patient). The patient resists, while the gymnast draws the arms forward till they are shoulder width apart. The patient then carries the arms back to the starting position, while the gymnast resists.

The arms must be kept fully extended and shoulders low. Repeat 3 to 6 times.

**Muscles Working.** Back fibres of Deltoid, Trapezius, Rhomboids, Latissimus dorsi, first eccentrically then concentrically in the inner range of movement. The extensors of back and hips and Triceps statically.

Is used to correct round shoulders by stretching the pectoral muscles and contracting the transverse shoulder muscles.

*Double Arm Flexion and Extension.* Positions for patient—stretch ly, stretch ½-ly, stretch sitting, stretch sit-lying, stretch stoop stride sitting. The gymnast stands at the patient's head and grasps her hands with the thumb grasp.[1]

The patient slowly flexes and extends both arms together: in flexion, drawing the elbows close to the sides; in extension, fully stretching the elbows and keeping the arms shoulder width apart. The gymnast gives steady resistance throughout. For each movement she says "bend" for flexion, and "stretch" for extension. The gymnast gives an over-stretching when the arms are extended, and slightly presses the elbows to the sides during full flexion. The patient must keep the elbows close to the couch throughout the movement. The exercise must be done steadily and smoothly. It is depleting from the internal organs, as many muscles work. Repeat 4 to 6 times.

If given in stretch-stoop-stride-sitting position the exercise has a further depleting effect on the organs.

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[1] The thumb grasp.—The gymnast grasps round the patient's thumb with her whole hand; the patient's hand closes over the gymnast's.

FIG. 52.—STRETCH HALF-LYING. DOUBLE-ARM FLEXION AND EXTENSION.

**Muscles Working.** For flexion in the elbow-joint—Brachialis anticus.

For adduction of shoulder—Pectoralis major, Teres major and Latissimus dorsi.

Acting on the sterno-clavicular joints to lower the shoulders—Pectoralis minor and subclavius; and to rotate the scapula inwards—Trapezius (middle fibres) and the Rhomboids.

For extension in the elbow-joint—Triceps.

For abduction of the shoulder—Deltoid and Supra spinatus.

Acting on the sterno-clavicular joints to raise the shoulders—Trapezius, Sterno-cleido-mastoid and Levator anguli scapuli.

There is also outward rotation of the scapulæ by Trapezius and Serratus magnus.

The extensors of the back work statically; also the flexors of the fingers to grip the gymnast's hand.

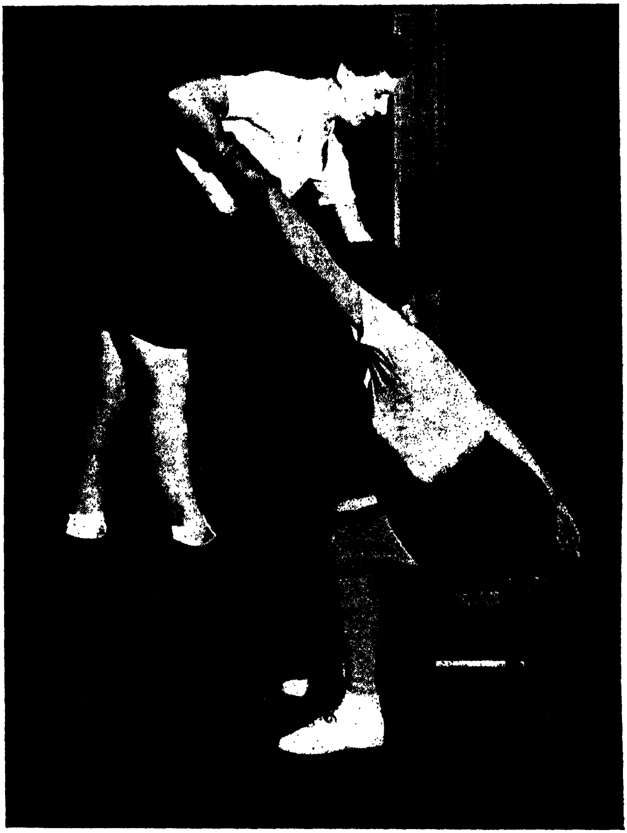

FIG. 53.—HALF-STRETCH, STOOP-STRIDE-SITTING, SINGLE ARM UP-STRETCHING AND DOWN-PRESSING.

*Half-wing, half-bend, stoop-stride-sitting, single-arm up-stretching and down-pressing.* The gymnast stands on a stool in front of the patient, grasps patient's wrist, and steadies the opposite shoulder with her hand.

The patient stretches her arm up, the gymnast resisting. The gymnast presses it down to the starting position, the patient resisting. The starting position must be maintained. The opposite arm is kept straight and carried slightly backwards. Repeat 4 to 6 times.

Is used in the treatment of scoliosis. The arm is extended on the side of the concavity of the curve.

**Muscles Working.** Extensors of the moving arm, viz., Triceps, and the forearm extensors.

There is also movement in the sterno-clavicular joint by Levator angulæ scapulæ, Sterno-cleido-mastoid and upper fibres of Trapezius.

There is outward rotation of the scapula by Serratus magnus and Trapezius.

At the same time the spinal muscles in the dorsal region are working on the opposite side to the moving arm.

When the patient stretches the arm the muscles all work concentrically in the inner range. In the second part of the exercise the same muscles work eccentrically in the inner range.

## Free Arm Exercises

### Exercises in Fingers, Hands and Wrists

The following may be used as exercises for patients with hand disabilities. They are also of value to students in training, to increase mobility and stretch the joints, thus preparing the hands for massage.

*Wrist shaking,* single and double.

*Making a fist, then opening the hand as far as possible and combining ulnar deviation at the wrist.*

*Flexion of metacarpo-phalangeal, while extending interphalangeal joints*

*Extension of metacarpo-phalangeal, while flexing interphalangeal joints.*

*Clasping the hands together, flexing and extending the wrists.*

*Placing the finger tips together, and pressing them out as far as possible*

*Placing index fingers and thumbs together and stretching.*

*Placing the hand palm downwards on a table, and drawing the elbow forwards.* (To increase wrist extension.)

*Placing the dorsal surface of the hand downwards and again drawing the elbow forwards.* (To increase wrist flexion.)

## Exercises in Shoulder-girdle, Shoulder and Elbow Joints

1. *Arm Bend Standing, Arm Rolling.* Finger tips on shoulders. The elbows are carried in large circles, outwards, backwards and downwards. 6 to 12 times.

*Note.* The movement is not done in the opposite direction, as it would tend to contract the chest.

2. *Shoulder Lifting and Sinking. Positions* Standing, sitting, lying 6 to 12 times.

3. *Shoulder Down-pressing and Raising to Starting Position.* For children lying position is best. The neck muscles are stretched at the same time. 6 to 12 times.

4. *Yard Standing, Free Double-arm Rolling.* Standing, the arms are extended sideways, and kept horizontal with the shoulders. They are then carried in small circles (movement in the shoulder-joints) first in one direction, then the other. Repeat 6 to 12 times each way.

5. *Standing, Single and Double Arm Circling.* A larger circle is made than in the last exercise. The arms are carried forwards, up, out and down. Done singly or together. 6 to 12 times.

6. *Arm Swinging. Positions.* Standing or sitting.

*Single-arm Swinging.* The limb must be fully relaxed and allowed to swing forwards and backwards. A small movement is begun, and allowed to get larger carrying it as far as possible, and then decreasing again.

*Double-arm Swinging.* The same, but both arms move.

*Alternate. Arm Swinging.* The same, but done alternately.

*Oblique Arm Swinging.* The same, but swinging obliquely.

Each 6 to 12 times.

*Arm Bend Standing, Arm Extension Upwards, Outwards and Downwards.*

1. Arms are extended upwards, elbows, wrists, and fingers fully stretched, arms kept shoulder width apart.
2. Hands brought back to starting position on the shoulders.
3. Arms are extended outwards to the horizontal position, level with the shoulders, and palms turned downwards.
4. Hands brought back to starting position.
5. Arms are extended down to the sides.
6. Hands brought back to the starting position.

*Cross Bend Standing, Arm Flinging.* The hands are placed across the chest, palms downwards, and finger-tips touching.

1. The arms are thrown briskly out sideways, but kept level with the shoulders. The patient should feel the scapulæ approaching each other.

*Shoulder-blade Exercise.* Standing, hands are clasped behind.

1. The hands are drawn sharply up to the waist.
2. The hands are fully extended. Repeat 8 to 20 times.

## Exercises Combining Arms and Trunk

*Sawing.* The patient stands with feet wide apart to give a steady base. The hands are clenched, the elbows flexed, and the forearms drawn up.

The arms are thrust alternately forwards (counting 1 ! 2 !) and back. At the same time the spine is rotated from side to side, the shoulders being brought alternately forward with each movement. The body is gradually bent forwards till the hands almost touch the ground. The arm movement is continued, while the body is raised to the starting position.

*Hewing.* The patient stands with feet wide apart, the hands clasped in front. The arms are raised over the head, and carried (1 !) down in a swinging movement, the whole trunk bending forwards and downwards (2 !), the body is raised to the starting position. Repeat 4 to 8 times.

# CHAPTER XIII

ASSISTED AND RESISTED ACTIVE MOVEMENTS—LOWER EXTREMITY :—Toes—Mid-tarsals—Ankle—Knee—Hip—Active movements with concentric work—Free movements—Resisted exercises combining movement in hip and knee—Knee movements—Free leg exercises—Balance walking.

## Assisted and Resisted Active Movements

### LOWER EXTREMITY

### TOE JOINTS

#### For Flexors and Extensors

POSITION for patient. Lying, half lying, back support sitting. For gymnast. Standing or sitting. If the latter, she supports the patient's foot across her knee, allowing the heel to be over the edge. The gymnast fixes the metacarpo-phalangeal joint with one hand, and resists with the other.

*Flexion.* The toes are plantar flexed by the patient, the gymnast resisting. They are carried back to the starting position by the gymnast, the patient resisting.

**Muscles Working Con. and Ecc.** Flexors on the sole of the foot and the Lumbricales.

*Extension.* The toes are dorsally flexed by the patient, the gymnast resisting. They are carried back to the starting position by the gymnast, the patient resisting.

**Muscles Working Con. and Ecc.** Extensor longus digitorum, and Extensor longus hallucis.

#### For Abductors and Adductors

*Abduction.* Done chiefly by the big toe. The movement is very slight in other toe-joints.

The patient abducts the big toe from the mid-line, the gymnast resisting. The gymnast carries it back, the patient resisting.

**Muscles Working Con. and Ecc.** Chiefly abductor hallucis.

*Adduction.* From the abducted position, the patient adducts the toe, the gymnast resisting, and from that position the gymnast draws it out away from the mid-line the patient resisting.

**Muscles Working Con. and Ecc.** The Plantar interosseii and Adductores obliquus and Transversus hallucis.

### THE MID-TARSAL JOINT

#### For Invertors and Evertors

*Inversion or Supination.* The position and holding is the same as for the passive movement (see p. 96.)

The patient turns the outer border of the foot towards the centre, the gymnast resisting. The patient holds the position, while the gymnast carries the foot back to the starting position.

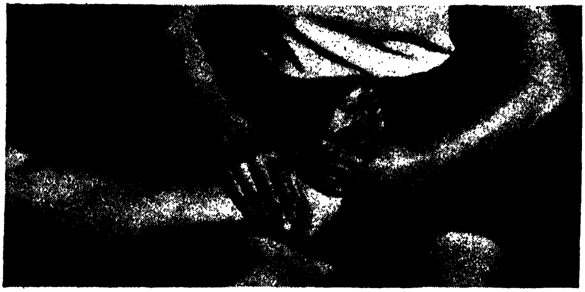

FIG. 54.—HOLDING FOR INVERSION AND EVERSION OF FOOT.

**Muscles Working Con. and Ecc.** Tibialis anterior and posterior.

*Eversion or Pronation.* The holding is reversed, the patient turns the outer border of the foot out as far as possible, the gymnast resisting. The patient holds and the gymnast carries the foot back to starting position.

**Muscles Working Con. and Ecc.** Peroneus longus and brevis.

### ANKLE-JOINT

#### For Dorsal and Plantar Flexors

The position and holding are the same as given passively.

*Dorsi-flexion.* The patient dorsally flexes the foot, the gymnast resisting. The latter then gives a strong pressure to increase the movement. The patient resists, while the gymnast draws the foot back to the starting position.

**Muscles Working Con. and Ecc.** Tibialis anterior, Peroneus tertius Extensor longus digitorum, Extensor longus hallucis.

*Plantar Flexion.* The position and holding are the same. The patient plantar flexes the foot, the gymnast resisting. The patient resists while the gymnast brings the foot back to starting position.

**Muscles Working Con. and Ecc.** Gastrocnemius, Soleus, and the deep muscles on the back of the leg.

## KNEE-JOINT

### For Flexors and Extensors

*Positions.* For patient—lying, half-lying, side and prone lying. When lying and side lying, the joint must be supported by the gymnast or in a sling.

When half-lying the position is the same as used for passive movement (see p. 97). The gymnast sits on the outer side of the joint moved, using her own knee as a support. She fixes the patient's knee with the hand nearest the joint, and with the other she grasps above the patient's ankle, allowing her fingers to remain on the posterior surface to give resistance during flexion.

*Note.* It is essential that the support under the knee raises the foot off the ground.

*Flexion.* If starting from full extension the patient flexes the knee, while the gymnast resists as explained above. After the patient has flexed the knee as far as possible, the gymnast draws it out to full extension, the patient resisting.

**Muscles Working Con. and Ecc.** The Hamstrings, Popliteus and Gastrocnemius.

*Note.* In the prone lying position the patient is well fixed and the fullest flexion can be obtained.

*Extension.* The positions are the same, but when given in half-lying the extension is done entirely against gravity. The patient extends the joint, the gymnast resisting. The gymnast carries the limb back to starting position, the patient resisting.

**Muscles Working Con. and Ecc.** Quadriceps femoris.

*Double Knee Flexion and Extension* may be given in the following positions :—

Sit-lying.
Forward-lying.

*Sit-lying Double Knee Flexion and Extension.* The gymnast fixes both knees with one hand and with the other resists above the ankles.

The patient alternately bends and stretches the legs, the gymnast resisting.

In this position the origin and insertion of Rectus femoris are farther apart than in half-lying.

**Working Muscles.** Flexors and extensors of the knees concentrically.

*Forward-lying Double Knee Flexion and Extension.* The gymnast fixes the thighs with one hand and gives resistance at the ankles with the other. The movement is done as before.

The exercise is sometimes used singly in this position, *e.g.* after injuries.

**Working Muscles.** Flexors and extensors of knees. The work may be done concentrically for each group, or concentrically and eccentrically for flexors or extensors as required.

## HIP-JOINT

### For Flexors and Extensors

The positions for patient are lying and half-lying.

The gymnast stands on the outer side and the holdings are the same as for rolling (see p. 98).

*Flexion.* From the extended position, the patient flexes the limb against the abdomen, the gymnast resisting. The gymnast draws it out again, the patient resisting.

*Note.* There is active flexion in the knee as well as the hip.

**Muscles Working Con. and Ecc.** Psoas, Iliacus, Rectus femoris, Sartorius, Pectineus, Adductores longus and brevis. The knee flexors also work.

*Extension.* Starting from the flexed position, the patient extends the leg, the gymnast resisting. The gymnast carries it back to the starting position, the patient resisting.

*Note.* There is also active extension of the knee.

**Muscles Working Con. and Ecc.** Gluteus maximus and the Hamstrings.

*Note.* The hip flexors and extensors are also in action with certain trunk movements.

### For Abductors and Adductors

*Single-leg Abduction. Positions.* Lying, crook half-lying. When given in crook half-lying the feet are supported on the couch. The gymnast places her hands on each side of the knee, resisting as the patient abducts the thigh. The gymnast returns the limb to starting position, the patient resisting.

The movement may also be done with the knee fully extended. Resistance is then given at the ankle.

**Muscles Working Con. and Ecc.** Gluteus medius and minimus. Tensor fascia lata.

*Single-leg Adduction.* In crook half-lying the movement begins from the abducted position. The patient adducts the thigh, the gymnast resisting on the inner side of the knee. The gymnast carries the limb back to abduction, the patient resisting.

**Muscles Working Con. and Ecc.** Adductores magnus, longus and brevis. Pectineus, Gracilis.

*Note.* For double hip abduction and adduction, see p. 126, viz., 2 knee parting and inpressing and 2 knee adduction and out-drawing.

### For Inward and Outward Rotation

*Rotation Inwards.* Position for the patient—lying or half-lying. The gymnast stands at the side.

There are two ways of giving the movement.

(*a*) The leg is fully extended. The gymnast grasps the foot and while giving some downwards traction, the patient turns the limb inwards, the gymnast resisting. The gymnast turns it back to starting position, the patient resisting.

(*b*) The gymnast flexes the hip and knee to a right angle, and holds it there by grasping round the knee with one hand. With the other she resists, while the patient turns the foot and lower leg inwards. The patient resists, while the gymnast carries the leg back to the starting point.

**Muscles Working Con. and Ecc.** Gluteus medius and minimus (ant. fibres), Tensor fascia lata.

*Rotation Outwards.* The position is the same, though the gymnast reverses her holding of the foot. She again gives traction, while the patient turns the limb out as far as possible, the gymnast resisting. The patient resists, while the gymnast carries the limb back to starting point.

**Muscles Working Con. and Ecc.** Obturators, Gemelli, and Quadratus femoris.

*Note.* The hip rotators may also be in action with movements of the trunk and pelvis.

### CONCENTRIC MUSCLE WORK FOR ALL GROUPS

**All the above movements may be done with concentric muscle work only, giving equal activity for flexors and extensors, abductors and adductors, etc. The patient does the movement, the gymnast resists. Commands are given by the gymnast, *e.g.* bend, stretch, raise up, draw down, etc.**

All the above movements may also be performed freely by the patient, according to instructions by the gymnast.

## Resisted Leg Exercises

### COMBINED MOVEMENT IN HIP AND KNEE-JOINTS

*Knee up-drawing and down-pressing.* May be done in the following positions :—

Lying.
Half-lying.
Stretch grasp standing.

*Half-lying.* The gymnast stands at the side and fixes patient's shoulder with one hand. She places other hand above patient's knee. The patient draws the knee up against the gymnast's resistance, carrying the limb towards the shoulder. The gymnast takes it up farther, then presses it down against patient's resistance.

The exercise is strongly repleting to the abdomen and pelvis and increases peristalsis.

*Stretch Grasp Standing.* The patient stands back to the rib-stools, and grasps the bars. Repeat 3 to 5 times.

**Muscles Working.** Flexors of hip-joint first concentrically then eccentrically, abdominal muscles statically.

*Leg up-drawing.* May be done in the following positions :—

Half-lying.
Stretch grasp lying.

*Stretch Grasp Lying Double Leg Up-drawing, also called Double Leg Flexion.* The gymnast stands at the end of the plinth and grasps patient's ankles with each hand.

The patient draws up both legs, parting the knees, the gymnast resisting. The gymnast brings legs back to starting position, the patient resisting. Repeat 3 to 6 times.

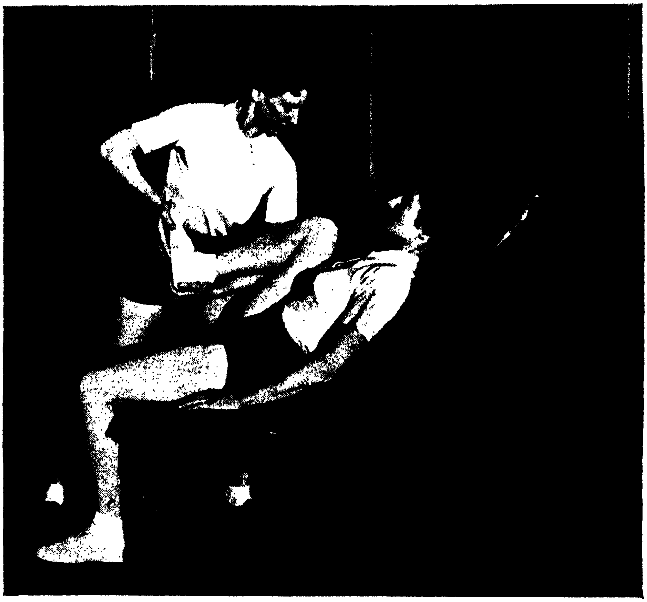

FIG. 55.—HALF-LYING LEG OUT-STRETCHING.

**Working Muscles.** (For single) the flexors of the hip and knee concentrically then eccentrically, abdominal muscles statically. (For double) the same for flexors, abdominal muscles concentrically and eccentrically.

*Half-lying, Leg Out-stretching.* The gymnast stands on outer side of patient's leg, and with one arm (L.) supports the whole of the patient's leg (R.) on her forearm, allowing the heel to lie in her hand. The other hand grasps the dorsum of the foot.

The gymnast carries the leg up into full flexion either passively or against slight resistance. The gymnast increases her power by leaning her shoulder against the patient's knee. The patient out-stretches the leg against the gymnast's resistance till the limb lies level with the plinth. Repeat 3 to 4 times.

The exercise is depleting from head and upper part of the body. Used in a general table.

**Muscles Working.** For the out-stretching—Extensors of hip and knee, viz., Gluteus maximus and Quadriceps working concentrically. If resistance is made by patient during flexion the same muscles work eccentrically. (Hamstring muscles do not work.)

*Crook-lying, Double Knee Parting and Impressing.* The gymnast stands at the side or end of plinth, and places a hand on the outer side of each knee. The patient parts both knees, while the gymnast resists. The gymnast presses them back to starting position, the patient resisting. 3 to 6 times.

**Muscles Working Con. and Ecc.** The abductors, viz., Gluteus maximus and minimus, and upper part of Glut. maximus.

*Crook-lying, Double Knee Adduction and Out-drawing.* The gymnast places the fingers of each hand on the inner side of the joints, and, starting from the abducted position, the patient adducts the knees bringing them close together, while the gymnast resists. The gymnast presses the knees back to starting position, the patient resisting. 3 to 6 times.

The last two exercises are useful to strengthen the muscles, and may be used before a patient is ready for weight-bearing exercises. They may also be given with pelvic lifting to strengthen the muscles of the pelvic floor. The patient may also practice self-resistance and use the movement as a home exercise.

## Free Leg Exercises

*Side-grasp Standing, Leg Swinging.* The patient stands with one arm outstretched sideways, and grasps a bar. The opposite hand hips firm. The patient stands on the edge of a low platform or on the floor. The leg swings on the same side as the grasping hand, backwards and forwards as far as possible. The knee is kept straight, and all movement comes from the hip. The body must be kept erect. Repeat 10 to 15 times. The patient turns round, grasps the bar with the other hand, and swings the other leg.

This is a pendulum movement and not much muscle work required. But there is alternate movement in both hips. First the moving leg swings forward, then when it swings back and reaches the frontal plane and past it, there is movement in the supporting hip-joint, also some bending in the lumbar spine (convexity forwards).

For mobility and circulation.

**Muscles Working.** Flexors and extensors of hip-joints, abdominal muscles (slightly), and muscles of lumbar spine (slightly).

*Single Hip Flexion and Extension. Position.* High side reach grasp standing.

The same as the last, but the leg is carried slowly backwards and forwards. The knee kept fully extended. Each 4 to 6 times.

*Heave Grasp Lying, Single Leg Lifting.* The patient lies on a couch, and grasps the corners, or on the floor and grasps a support.

1. The right leg is slowly raised, till it is at right angles with the body; the knee is kept fully extended.
2. The leg is slowly replaced on the couch, and the knee still kept extended during the sinking.
3. The left leg is raised in the same way.
4. The left leg is replaced in the same way. Repeat 3 to 6 times.

The patient must breathe freely during the exercise.

Good for co-ordination of movement.

**Muscles Working.** During the lifting flexors of the hip work concentrically, and extensors of the knee statically. During the sinking flexors of the hip and extensors of the knee work eccentrically.

*Heave Grasp Lying, Double Leg Lifting.* This is the same as the former, but both legs are lifted together. The sinking should be done very slowly.

Repeat 3 to 6 times.

It may be used as an abdominal exercise. If the legs are carried over the head, it stretches the lumbar spine and corrects lordosis.

The muscle work is the same, except that abdominal muscles come into play, and work statically.

*Hips Firm Standing, Alternate Knee Raising.* The patient stands with heels together and toes turned slightly out. The hands are placed on the hips, keeping the elbows in a line with the body. The knees are raised alternately as high as possible, keeping the lower leg straight and the toe pointing to the floor, in the following order :—

1. Raise the right knee.
2. Replace the right foot.
3. Raise the left knee.
4. Replace the left foot.

Repeat 6 to 12 times.

A balance exercise. Good for innervation. Also, when knee is brought up sharply against the abdominal wall, it stimulates the organs, and so is good for constipation.

**Working Muscles.** Of moving leg : when raising—Flexors of hip concentrically ; when lowering—slightly eccentrically, abdominal and spinal muscles statically. Of standing leg : Extensors of hip statically.

*Hips Firm Standing, Alternate Knee Raising with Leg Extension.* The first part of this exercise is the same as the former, but after the knee has been raised the lower leg is extended. It is performed in the following order :—

1. Raise the right knee.
2. Extend the lower leg.
3. Bend the knee as before.
4. Replace the foot on the floor.
5. Raise the left knee.
6. Extend the lower leg.
7. Bend the knee as before.
8. Replace the foot on the floor.

Repeat 4 to 8 times.

Owing to the increased muscle work it is a harder balance exercise than the previous one.

**Working Muscles.** The same as previous exercise, but after the hip flexors have raised the thigh, the knee extensors work strongly concentrically to extend the lower leg. When the knee is again flexed the same group works slightly eccentrically.

*Wing Standing, Heel Raising, and Knee Bending.* The exercise may also be done in the following positions :—

| | |
|---|---|
| Neck firm<br>Reach grasp<br>Stretch | Standing. |

In time to counting :—

1. The patient rises on tip-toes.

2. The knees are well parted and slowly flexed. (The back must be kept straight.)

3. The patient again rises on to tip-toes.

4. The heels sink down to the floor. Repeat 4 to 8 times.

Specially strengthens extensors of the knees, and a good balance movement.

**Muscles Working.** During 1 : The calf muscles work concentrically. The extensors of hips and spine statically. During 2 : The extensors of the knees eccentrically to prevent the body sinking too quickly by its own weight.

During 3 : The extensors of the knees strongly concentrically to raise the body. Also the calf muscles concentrically to keep the heels raised. Extensors of hips and spine statically.

During 4 : The calf muscles eccentrically : *i.e.* when the heels slowly sink to the ground.

## BALANCE WALKING

A bar raised off the ground is used for balance walking. It may also be done along a line or strip or in spaces suitably marked on a mat or on the floor. The exercises may be made more difficult by altering the position of the arms to yard, neck firm, or stretch ; also by placing a book on the head during the exercise. It improves posture, co-ordination, and balance.

The following are suggestions—they may be varied according to requirements :—

The patient starting in wing-standing position.

1. Marching in spaces.
2. Tip-toe marching.
3. Marching with alternate knee raising.
4. Repeat No. 3, and add leg extension.
5. Marching in spaces with heel raising and knee bending between the steps.
6. Marching, placing each foot : heel ! outer border ! toe !

FREE EXERCISES for Flat Foot (see p. 258).

# CHAPTER XIV

TRUNK EXERCISES :—Passive trunk movements—Combined active work for trunk and hip muscles—Back and hip extensors—Abdominal and hip flexors—Free trunk exercises—Resisted active exercises for head and neck.

## Passive Trunk Movements

CERTAIN passive trunk movements were formerly taught, but are not now used. Their place is taken by various types of free trunk and breathing exercises.

## Exercises giving Combined Active Work for Trunk and Hip Muscles

### BACK AND HIP EXTENSORS

*Wing Stride Lax-stoop Sitting, Back Raising.* The gymnast stands in front of the patient, placing his hands over the scapulæ. The patient raises up gradually into the sitting position, against the gymnast's resistance. The lumbar part of the spine must first be extended, next the dorsal, and finally the neck. The shoulders must be drawn back, and a good position of the head maintained. The corrected position should be held for a few seconds.

The exercise is much used to strengthen the spinal muscles. It can be easily modified. It may be given with respiration. Repeat 4 to 6 times.

**Muscles Working.** The first part of the exercise may be passive, but if resistance is given, the extensors of hips, *i.e.* Gluteus maximus, and extensor of the spine, *i.e.* Sacro-spinalis, work eccentrically.

To raise up, the extensors of the back and hips work concentrically. To hold the position, they work statically.

At the end of the movement the prevertebral muscles and back shoulder muscles work statically to correct the position of chin and shoulders.

*Lax-stoop Stride Sitting. Back Raising with Head Support.* The patient rests both hands on her thighs. The gymnast stands at the side, and places one hand on the back of the head, and the other between the shoulders. She resists, while the patient raises to a sitting position, helping with her arms. The exercise is done in time with respiration, breathing out while going forward. The patient gives slight resistance when taken back to starting position.

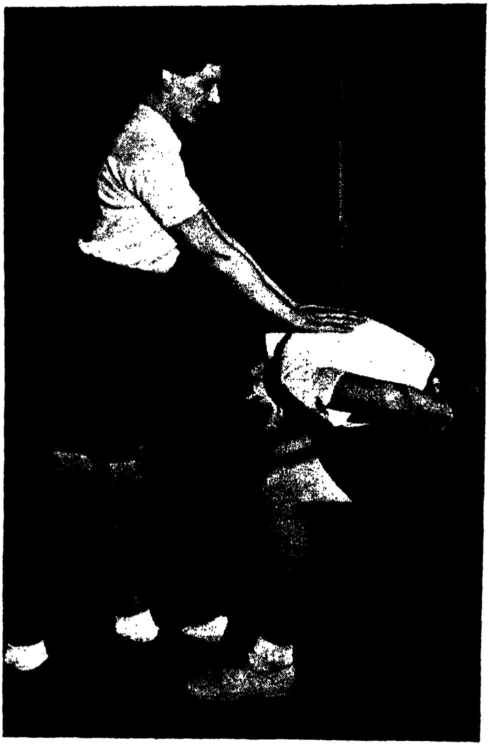

FIG. 56.—WING STRIDE STOOP SITTING, BACK RAISING.

**Working Muscles.** The extensors of the spine and hips, concentrically when raising, eccentrically when going forward, as in preceding exercise. But the muscle work is stronger for the neck and prevertebral groups.

*Back Raising in Different Planes.* May be done in sitting or lean standing. The starting position and holding are the same as last exercise.

The raising is first done forwards as before, and then from right- and left-turn stoop positions. The gymnast supports the patient's toe with her own.

The exercise is stronger than the previous one, and owing to some widening and compressing of the thorax, the lungs are more used. It is done in time with respiration.

**Working Muscles.** Mainly the same as preceding exercise, but in rising from the turn position the muscles on the opposite side of the spine do stronger work than those on the same side as the turn position.

## ABDOMINAL MUSCLES AND HIP FLEXORS

*High-ride Sitting, Backward Falling and Raising.*

*Positions.* Wing, neck rest, stretch.

The patient's knees are fixed by a strap. This is a free movement, but the gymnast stands near, and gives support if necessary. The patient falls slowly backwards, maintaining a correct position of the head and trunk. She then raises to the sitting position. The backwards falling is gradually increased, according to the patient's strength.

Repeat 3 to 6 times.

**Muscles Working.** Flexors of hips, *i.e.*, Psoas and Iliacus, eccentrically and concentrically in the outer range of movement. Static work for abdominal muscles.

*Wing, Sit-lying, Raising, and Sinking.* The gymnast stands in front of the patient and fixes her knees.

The patient rises to sitting, then slowly returns to starting position.

The back must be kept fully stretched. The head and shoulders leave the plinth last in raising. The head touches the plinth first in sinking. It may be done in time with respiration.

This exercise may be modified by raising the long end of the plinth, so that the patient does not sink so far back as in sit-lying position. It is repleting to the abdomen and pelvis, and used in the treatment of constipation.

**Muscles Working.** Flexors of the hips, *i.e.*, Psoas and Iliacus, concentrically when rising, and eccentrically when sinking back. The abdominal and back muscles statically.

*Note.* Trunk flexion and rotation and rotation of the pelvis are given freely (see below and p. 239).

## Free Trunk Exercises

*Wing Stride Standing, Trunk Rolling.* A good position of the trunk and head must be maintained, and the knees kept fully extended. The trunk is then carried in large circles in the following directions :—

(*a*) Forwards, right, back, left, forwards. Repeat 6 to 8 times. Raise to starting position.

(*b*) Forwards, left, back, right, forwards. Repeat 6 to 8 times. Raise to starting position.

If there is any tendency to lordosis, the flexion backwards should be limited, in the forwards direction it should be carried as far as possible.

It increases mobility in the spine. Stimulates the digestive tract, and increases peristalsis. It also improves the general and portal circulation.

**Muscles Working.** The abdominal, lateral and back muscles of the trunk work alternately.

*Wing Stride Standing, Trunk Bending Forwards and Raising,* The back is kept flat, movement taking place in the hip-joints.

1. The trunk bends forward slowly, as far as possible, keeping the knees in full extension.
2. The trunk is raised to the starting position. Repeat 3 to 6 times.

**Muscles Working.** During the flexion forwards, extensors of the hip work eccentrically, the back muscles statically. During the raising, extensors of the hip work concentrically, the back muscles statically.

*Wing Tailor Sitting.* The patient sits cross-legged on the floor. *Trunk bending forwards and backwards. Trunk alternate side bending. Trunk alternate side turning.* These movements to be done very briskly in time to counting 10 to 20 times each. They may also be done in high-ride sitting position.

Increases mobility in joints of the spine.

**Muscles Working.** There is concentric work for the various groups which have already been described in similar movements.

*High-ride Sitting. Trunk turning with arm throwing.* The knees fixed by strap. The patient turns alternately from side to side, throwing the arms over together. Done briskly 6 to 10 times.

Increases mobility in joints of spine.

**Muscles Working.** The rotators of the trunk.

*Stretch Stride Standing, Forwards and Downwards Bending.*
1. The whole trunk is carried slowly forwards and downwards to the floor. The knees are kept extended throughout, but the back is rounded. The patient tries to touch the floor with the fingers.

2. The trunk is raised to the starting position. Repeat 3 to 6 times.

Deep breathing may be added to this exercise; expiration taking place during the forward bending.

Strengthens the working muscles, specially those which extend the spine.

**Muscles Working.** The body weight carries the trunk forwards. During the raising, the extensors of the hip and back work concentrically, the extensors of the arms statically.

*Close Standing, Alternate Trunk Side Bending.* The trunk is laterally flexed to each side. The exercise is usually performed with deep breathing as follows :—

1. In starting position. Breathe in.

2. Bend to the right as far as possible (the bending should be purely lateral, no twisting), and breathe out.

3. Raise to starting position, and breathe in.

4. In starting position, breathe out.

Repeat the series to the left. Repeat 4 to 6 times.

The lateral flexion stretches the soft parts on the side of the thorax away from the bending. During flexion more space is given to the lung for expansion on the side away from the bending. If pleural adhesions are present, extra flexions should be given away from the side where they exist.

**Muscles Working.** The lateral muscles of the trunk work concentrically as in side bend standing, see p. 85.

*Wing Close Standing, Alternate Trunk Side Turning.*

1. Turn trunk to right as far as possible.
2. Return to starting position.
3. Turn trunk to left as far as possible.
4. Return to starting position. Repeat 6 to 10 times.

The face must be kept in a line with the centre of the body.

The patient should be instructed to draw in the abdominal muscles during the movement. Deep breathing may be added ; expiration taking place during the forward turning. The muscles which rotate the trunk are working concentrically throughout.

It strengthens the working muscles, and is especially used for lax abdominal walls. It also increases peristalsis and mobility of the spine.

**Muscles Working.** The rotators of the trunk work concentrically as in turn standing, see p. 86.

*Note.* Special exercises for spinal deformities, see pp. 235 to 243.

## Resisted Active Exercises for Head and Neck

Passive movements in this region are already given on p. 99. There is movement in the cervical vertebræ and between atlas and the occipital bone.

The axes are : —

Frontal for flexion and extension.
Sagittal for side bending.
Vertical for turning or rotation.

Positions for the patient are :—

Lying, and crook lying (head over plinth).
Sitting and close sitting.

### For Extensors

*Extension or Flexion Backwards.* The gymnast grasps the patient's head with one hand at the border of the hair in front, the other hand grasps at the base of the skull, or else the head is allowed to lie in the palm of the hand.

The patient bends head back, the gymnast resisting. The gymnast raises it forwards to mid-line, the patient resisting.

In bending head back the patient must keep the chin in and so move the joints of the cervical spine first. Then allow chin to be raised, when movement will take place between atlas and the occipital bone.

In raising forwards the chin must first be drawn in, which again allows moving between atlas and occipital, and then the cervical joints are flexed forwards.

**Muscles Working Con. and Ecc. in Inner Range.** To extend the cervical joints—the upper part of Sacro-spinalis, Multifidus spinæ and Splenius cervicis. To extend the atlanto-occipital joints—Splenius capitis semi-spinalis capitis, Rectus capitis posterior major and minor, Superior oblique, and upper fibres of Trapezius.

### For Flexors

*Flexion Forwards.* If given in lying position, the patient raises the head off the pillow, while the gymnast gives slight resistance at the border of the hair. The head is then allowed to fall back.

If given in sitting, the same holding may be used as for the preceding exercise, the patient carries the head forward with slight resistance, and raises it again.

**Muscles Working Con. and Ecc. in Inner Range.** For the flexion —Sterno-mastoid and the prevertebral muscles. To raise the head to the starting position—the extensors of the neck as in the preceding exercise.

This head raising causes the Rectus abdominis to contract, so the exercise is used to strengthen the abdominal muscles when a patient is lying in bed.

The flexion backwards and forwards may be combined, when the groups would work in the whole range of movement.

The movement may also be given with the head over the end of the plinth, the gymnast holding as for extension.

### For Rotators

*Head Rotation or Head Side Turning.* The positions are the same as for extension, but the gymnast stands behind and grasps the head in the hollows of her hands beneath the mastoid processes.

The patient turns to right or left, the gymnast resisting.

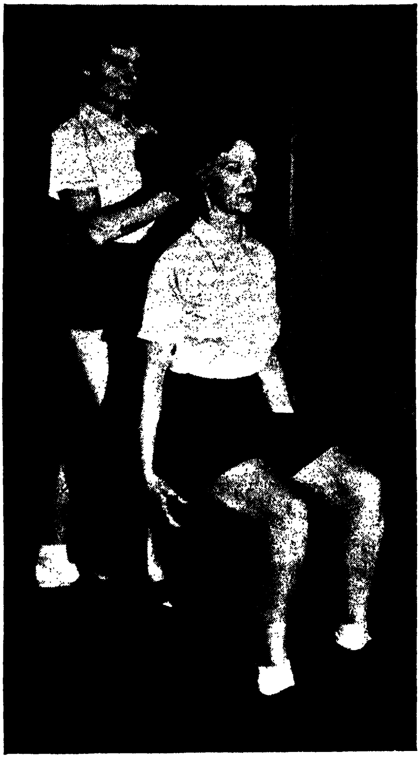

FIG. 57.—HOLDING FOR HEAD SIDE TURNING AND BENDING.

The gymnast carries the head back to the mid-line, the patient resisting.

**Muscles Working Con. and Ecc. in Inner Half of Range.** The Oblique muscles of the neck. In front, from left below to right above. On the back, from right below to left above. The Sterno-mastoid muscles are the most important rotators of the neck.

*Note.* This movement is required in the treatment of torticollis (see p. 221).

### For Side Flexors

*Head. Flexion Sideways, or Head Side Bending.* The positions and holding are the same as for head rotation.

The patient bends the head to right and left, the gymnast resisting. The gymnast brings the head back to the mid-line, the patient resisting.

**Muscles Working Con. and Ecc. in Inner Half of Range.** The right or left side flexors of the head according to the movement done.

*Note.* Also required in the treatment of torticollis.

## Combined Head Side Turning and Bending for Torticollis

The patient sits and grasps the stool on each side to fix the shoulders.

The gymnast stands behind, supports the patient's back with her own body, while she grasps with one hand under the

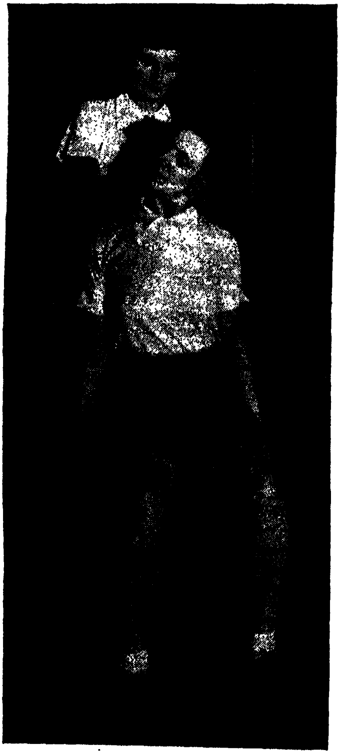

FIG. 58.—HOLDING FOR COMBINED HEAD SIDE TURNING AND BENDING.

chin, and the other over the top of the head, the fingers of each hand pointing in opposite directions.

The patient turns to one side while flexing the head the opposite way. The gymnast resists, but at the extremity of the movement carries the head a little further than the patient can accomplish. The patient then resists or " holds " in this position, while the gymnast carries the head back to the mid-line.

The movement is done in one direction only according to the deformity.

# CHAPTER XV

WARD EXERCISES :—General notes—Pre-operative instruction—Routine ward exercises—After abdominal operations.

THE importance of exercises given during the time a patient lies in bed is now widely recognised. This especially applies before and after surgical treatments. Great benefit is derived from breathing exercises done regularly before an anæsthetic is taken, while simple active movements are useful in preserving muscle tone, also stiffness and loss of mobility are prevented. In hospital wards, therefore, a regular routine of exercises is given to patients, a physiotherapist attending from the hospital department to teach what is necessary and to see that the movements are carried out.

The physiotherapist refers to patient's notes, and confers with the sister in charge as to whether a patient may be taught routine exercises, and she directs accordingly. She aims at giving each patient a few minutes' individual instruction, teaches diaphragmatic breathing, muscle contractions, and simple active exercises.

Later the patients can sometimes do exercises together working in groups.

Pre-operative instruction is important. The patient should learn correct breathing, and prepare for the post-operative time. Further details of this are given after the routine ward exercises.

It is usual for 14 days to elapse between the discharge of an in-patient and his ability to attend an out-patient department for further treatment. This fortnight is often spent in inactivity, and a marked increase in muscular weakness occurs. It is therefore essential for the deep breathing and active exercises to be carried out at home. This method has the advantage of keeping contact with the patients between the in- and out-patient period.

The following is an outline of routine ward exercises which may be varied and reduced by the discretion of the physiotherapist according to the patient's strength and condition.

## Routine Ward Exercises

Lying or half-lying. Deep breathing. 4 to 8. (Diaphragmatic and costal.)

Muscle contractions of:—

Quadriceps.
Gluteii
Abdominal } 4 to 10 each.
Pelvic floor

Clench the hands, spread fingers and reclench. 6 to 12.
Double elbow flexion and extension, and alternately. 4 to 6.
Double-arms bend. Double-arm abduction and adduction. 4 to 6.
Arms forward bend. Double-arm flinging. 4 to 6.
Head rolling. 4 to 6 each way.
Head forward, raising and sinking
Head backward bend and raising } 4 to 6 each.
Head side bending to R. and L.
Head side turning to R. and L.
Repeat deep breathing.
(Loosen bedclothes.)
Foot rolling. 4 to 6 each way.
Double foot flexion and extension and alternately.
Foot turning in and out.
Single and double knee raising and sinking, and alternately (placing foot on the bed).
Crook half-lying, knee parting and closing.
Alternate trunk side bending.
Repeat deep breathing.
Muscle contractions may also be repeated.

The ward exercises should occupy 5 to 15 minutes and be done once or twice daily.

## Details of Massage and Exercises after Abdominal Operations

After an abdominal operation a patient suffers from shock due to the surgical interference. All the functions of the body are slowed down. The action of the heart is temporarily disordered. The blood flow slows down, bringing risks of clot formation in the veins and of pulmonary embolus. The muscles become feeble and toneless, this condition also affecting the veins and lymphatic vessels.

Constipation is often present, and though it may be the result of drugs taken to ease pain, it is also probably due to a general slowing of the bodily functions and the result of immobility.

The breathing mechanism is working at a minimum, for the interchange of gases both in the lungs and the tissues are at their lowest. Added to this the patient may experience great stiffness and pain in the hip-joints, lumbar spine and sacro-iliac joints as the prolonged half-lying position tends to cause a strain in these regions.

The object of physical treatment, when it is allowed for such a condition, is to gradually strengthen the patient, and to help the functions of the body to return to normal.

The circulation, the nervous system, respiration and muscle tone are all assisted.

Breathing exercises are resumed as soon as a patient recovers from the anæsthetic, but further physical treatment is postponed until stitches have been removed. Gentle massage to the limbs may then begin, and the back and gluteii are treated as soon as the patient is allowed to turn on his side.

Abdominal massage is not given unless specially ordered, but flatulence often disturbs the patient in the early stages, and it may be relieved by rhythmical stroking over the stomach, and along the course of the colon. The stroking is done over the bandages.

At the next stage, the patient does a series of muscle contractions and relaxations, gradually giving active work to all the muscles of the body. By this method, the patient actually moves very little, so there is not much risk of over-activity, but the muscles are innervated, and their function is assisted.

If the patient has learnt to do muscle contraction and relaxation before the operation, he can resume the exercises with greater ease. Eventually he practises the contractions several times a day.

They are done in the forearm, shoulder, calf-muscles and quadriceps, and at a later stage in the back shoulder group, the gluteii and abdominal muscles, and those of the pelvic floor. The sacro-spinalis should be contracted by arching the back in bed, and relaxing again.

Special attention must be paid to restoring the abdominal wall, and the patient's general posture must be considered when he or she begins to get up.

Much depends on the age and condition of the patient, and the nature and severity of the operation, but if permission is given for further treatment to strengthen the patient by physical means, exercises are progressed to re-educate the muscles before the patient attempts walking. Foot movements are important to prevent flat foot, which may otherwise occur from weakness.

The patient should practise free toe flex. and ext. and spreading. Foot rolling. Free double and alternate foot flex. and ext. The physiotherapist gives resisted foot flex. and ext. and inversion con. and ecc.

Knee movements may be given before walking is allowed. The patient sits on the side of the bed and swings his knees together and alternately. Active knee flex. and ext. is also given with resistance. When the patient begins to walk he should wear comfortable but firm shoes—not bedroom slippers.

As the patient progresses the following exercises, still done on the bed, are useful.

The deep breathing is continued, also muscle contractions of the abdomen, gluteii, and the pelvic floor.

Lying, trunk side-bending, drawing the lower border of the ribs towards the iliac crest.

Lying alternate knee-lifting (foot placing) and sinking.

Half-lying (propped with pillows), trunk-raising to sitting and sinking. The physiotherapist holds the patient's hands and assists the movement.

Lying, hip-lifting (keeping the leg quite straight). Also called leg shortening.

Sitting, head-bending backwards and raising and head side-turning to R. and L.

# CHAPTER XVI

RESPIRATION :—The Respiratory forces—Inspiration—Expiration—Vital capacity—Respiratory muscles—Uses of breathing exercises—How to teach deep breathing—Chest clapping.

RESPIRATION is due to a rhythmic expansion and contraction of the thorax, which causes air to flow in and out of the lungs. By this means oxygen, which is essential for life, is taken into the system and carbon dioxide is given off.

The thorax is an airtight cavity, and its walls are formed by the ribs and intercostal muscles and its base by the diaphragm.

The lungs are elastic bags, and they fill the whole of the thorax, except for the space occupied by the heart and great blood-vessels.

The flow of air in and out of the lungs is controlled by (*a*) the constant force of atmospheric pressure ; (*b*) by the elasticity of the lungs, which varies in extent, and also by the size of the thorax, which varies too according to muscular action.

If a pair of lungs removed from the body of an animal be inflated with air, and then the pressure holding that air be released, the lungs at once collapse as the air escapes through the trachea. Now, normal lungs within the body do not collapse like the removed ones, although they are in communication with the outside air through the trachea.

The reason why the removed lungs collapse is that they receive the pressure of the air on both inner and outer surfaces, therefore the pressure is equalised, and the elastic tissue acts unopposed, while in the normal condition within the body atmospheric pressure on the outer surface is prevented by the resistance of the chest wall. Therefore the pressure of the air within the lungs inflates them. This does not happen, however, without changes in the size of the thorax.

" The movements which take place during inspiration and expiration set up differences of pressure between the inside and outside air, and in both cases the movement of air follows the general law that air passes from a region of higher to a region of lower pressure.

"The movements of the elastic lungs follow those of the thorax by contraction of certain muscles—the thorax is enlarged at intervals—the lungs expand to occupy the increased space, and the pressure in the lungs becoming less than that outside in the atmosphere, a rush of air from the atmosphere through the trachea takes place to establish equilibrium of pressure. This act constitutes **inspiration.**" (*Thornton.*)

**Expiration** is due mainly to the elastic recoil of the lungs and thoracic walls, the size of the cavity decreases, causing the pressure inside to be greater than that outside, and so the air rushes out.

During life, "*residual*" air is always within the lungs. That which passes in and out during respiration is known as "*tidal*" air. By a forced expiration "*supplemental*" air may be expelled, and by a forced inspiration "*complemental*" air may be made to enter the lungs.

## VITAL CAPACITY

The vital capacity of a patient is measured by breathing into a spirometer.

In normal breathing about 500 c.c. of air pass in and out of the lungs with each breath.

If an effort is made to breathe in to the fullest extent a further 1,000 c.c. or more can be inspired (complemental). A similar effort can give an extra 1,000 c.c. in expiration (supplemental).

The vital capacity is the sum of these figures, and the amount that a patient can push into the meter from the height of inspiration to the extreme of expiration.

The figures vary with individuals. They fall with illness and after operations. They recover slowly under exercise.

## THE RESPIRATORY MUSCLES

Ordinary inspiration takes place due to the contraction of the following muscles: (*a*) The diaphragm. When this muscle contracts it becomes flatter to the thorax, the sides descending most. Owing to its descent, the thorax is enlarged downwards, and the abdominal walls bulge forwards, owing to the pressure on the organs. "From its attachment to the sternum and false ribs it tends to pull these down and inwards, but its action in this respect is counteracted partly by the vertical direction of the fibres attached to the ribs, and partly by the elevation of the ribs that accompanies the descent of the diaphragm" (*Thornton*). The following muscles elevate the ribs, and so enlarge the thorax from side to side, and from back to front: (*b*) The Intercostals. (*c*) The Scaleni. (*d*) The Levatores costarum.

Ordinary expiration is caused by the elastic recoil of the lung tissue and costal cartilages, which have been put on the stretch during inspiration, aided by the action of abdominal muscles.

In extraordinary or forced inspiration, the following other muscles work to increase the size of the chest: Quadratus lumborum, Serratus posticus superior, Sterno-mastoid, Serratus magnus and the Pectoralis major and minor. The last three muscles help to lift the ribs when the arms and shoulders are fixed.

In extraordinary or forced expiration, the abdominal muscles come further into play, their action forcing the abdominal viscera and the diaphragm upwards. Triangularis sterni and Serratus posticus inferior also take part.

## THE USES OF BREATHING EXERCISES

The main use of breathing exercises is to enable the patient naturally to fill all parts of his lungs with air.

The result of this properly performed will be :—

(*a*) To maintain the natural elasticity of the lungs and mobility of the thorax.

(*b*) To increase the intake of oxygen and the giving off of carbon dioxide.

(*c*) To improve both the systemic and pulmonary circulation.

(*d*) By increased action of the diaphragm to give additional pressure upon the abdominal organs, and so improve their functions.

(*e*) To prevent formation of adhesions, or if present to stretch them.

## HOW TO TEACH DEEP OR LOWER CHEST BREATHING

*Position.* For the patient. Crook half-lying. The patient lies on a couch, head and shoulders raised by pillows.

Relaxation of the whole body must be learnt. The patient is then instructed that normal deep or lower chest breathing is done by expanding the lower costal region during inspiration, while at the same time the diaphragm descends and the abdominal wall relaxes, but must not be *forced* forward. During expiration there is an elastic recoil of the chest wall, the diaphragm rises, the abdomen is flattened.

The patient learns to feel these movements by placing his hands lightly on the lower front ribs, or the physiotherapist directs the movements by laying her hands in the same region during inspiration.

During expiration the patient contracts the abdomen pressing the spine against the couch.

For those who have difficulty in controlling the breathing, the physiotherapist places his hand in the lumbar region and urges the patient to press down against it during expiration.

The breathing should be slow and rhythmical.

When as much air as possible has been taken in, expiration should at once begin, and plenty of time allowed for it.

In deep diaphragmatic inspirations the bases of the lungs are expanded ; in full costal inspirations the lateral and upper regions are more fully expanded. Both inspiration and expiration should take place with the mouth closed, though in some conditions it is allowable to part the lips during expiration. To breathe *in* with the mouth closed is very important. Non-observance of this habit is the cause of adenoids and nasal trouble in later life.

Children should be encouraged to shut their mouths. Mouth breathing may be employed on account of some nasal obstruction, but it is often a habit which can be overcome by perseverance.

Breathing exercises are used with great advantage in many conditions, *e.g.* patients lying in hospital for various reasons are instructed to practise deep breathing. This is specially important before and after surgical operations (see pp. 141, 312). In respiratory diseases the exercises are given in a variety of ways. It is necessary to distinguish between

$$\left.\begin{array}{l}\text{Apical}\\\text{Lateral costal and}\\\text{Diaphragmatic}\end{array}\right\}\text{breathing.}$$

Surgical and some medical conditions call for one-sided and localised work for different parts of the chest with resistance to strengthen the movements (see p. 312). Breathing is also important in some disorders of the alimentary tract, in the treatment of spinal deformities, nervous and other conditions.

### CHEST CLAPPING

*Position.* For the patient. Neck rest, walk standing.

The gymnast stands in front, and places her foot beside the patient's, and thus gives a little support.

The gymnast places one hand each side of the patient's back, and begins the clapping high up, gradually working to the lower part. The sides of the thorax are then covered, and

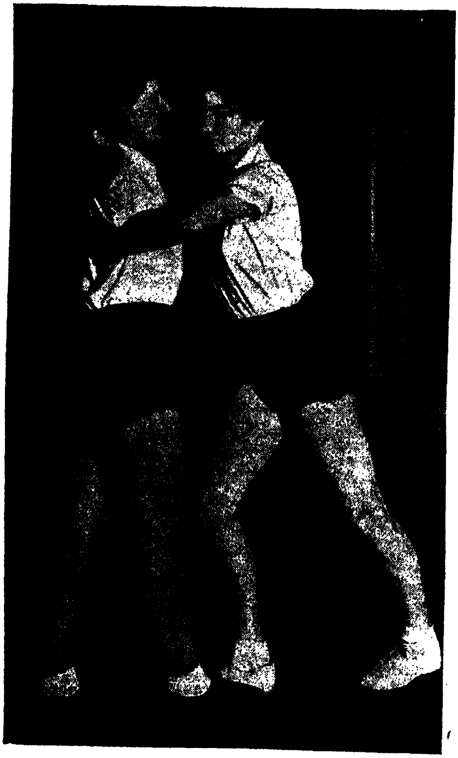

FIG. 59.—NECK FIRM, WALK STANDING, CHEST CLAPPING.

the hands still clapping are brought round to the front. No clapping is done below the ribs. Light hacking is given up the sternum and a little light hacking or clapping upon the upper part of the chest in front. The hands are then carried round to the back again, and the whole series is repeated 3 to 4 times. The clapping should be immediately followed by deep breathing. 4 to 8 times.

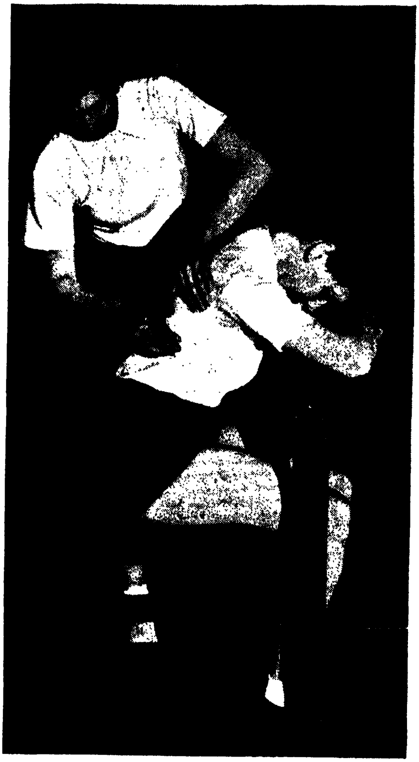

FIG. 60.—CHEST CLAPPING, THE PATIENT SITTING.

For weak or elderly patients, the clapping may be given with the patient sitting leaning over a support. The gymnast then stands at the side and gives the clapping in much the same way as during back massage, but the whole thorax must be covered. When the chest is treated, the patient may sit back in an armchair.

*Effects and Uses.* It stimulates and strengthens the thoracic organs, and helps the exchange of gases in the lungs. It helps expectoration, and is used for those lung diseases which are suitable for gymnastic treatment, *viz.* chronic bronchitis, and during the after-treatment of adenoids, pleurisy, and pneumonia.

# CHAPTER XVII

REHABILITATION :—After surgical and medical treatment—Centres for rehabilitation—Occupational therapy—Treatment of amputation stumps.

As well as all forms of physical treatment coming under the comparatively new term " Physiotherapy," another word has come into general use—REHABILITATION. It is used in a wide sense and has been applied to various subjects such as the restoration of war devastated countries, the re-clothing and re-housing of evacuees, the re-establishment of finance, and the restoration to health, both physical and mental, of the sick and injured. It is this last aspect which concerns us here. It means a reconditioning of those who have lost their health, and in many cases normal movements and functions have to be restored.

This reconditioning includes muscle re-education already dealt with in Chapters VII and VIII. In fact, it embraces all physical means of restoring to health and usefulness those who have been incapacitated.

During and since the war it has been all too necessary to consider and care for persons crippled and injured by enemy action, including those serving in His Majesty's Forces and many civilians who were exposed to danger and injury.

People of all ages and both sexes have required treatment for such conditions as fractures, burns, wounds, shock, nervous tension, strains, etc.

Subsequent to surgical and medical treatment and also to skilled nursing and physiotherapy they come to be rehabilitated. Not only do patients receive such treatment as dealt with in these pages and administered in hospitals, clinics and to patients in their homes, but rehabilitation centres are now established. These centres are sponsored by the Ministry of Health. After the early physiotherapy the patient passes on to heavy exercises and graded occupations which he carries out under supervision until fit to return to normal work, *e.g.* a miner who has been laid up for weeks with a fractured femur, or an injury to his back. Physical treatment begins before he leaves his bed, but eventually he recovers his full powers by performing very strong exercises, and some form of manual labour, so that he leaves the centre ready for " full duty." There are also highly trained persons teaching what is known as " Occupational Therapy." This is some form of hand-work designed to help the partially disabled patient. Many hospitals now have such departments, so that after receiving physiotherapy a patient goes to this other department where the manual occupations are practised, *e.g.* toy making.

Movements carried out during the work chosen help to continue the cure, and the interest taken by the patient is a great incentive to their recovery.

Excellent books are now published giving extensive details of work done in rehabilitation centres, and others dealing with occupational therapy. For further information on these subjects see Bibliography (p. 414).

## AMPUTATION CASES

As the result of injuries to men in the services and also those sustained by civilians in air raids, many cases of amputation have come into the hands of the physiotherapist in recent times.

Miss K. M. Ward and Miss L. B. Martin, of the Royal Sussex County Hospital, Brighton, have written of their experiences in these cases, and by their kind permission their notes on the subject are here reproduced.

## THE TREATMENT OF LOWER LIMB AMPUTATION CASES

Treatment is directed to (1) the prevention of deformity, and (2) the restoration of function, and may be divided into three stages, all directed towards exercising the muscles moving and stabilising the remaining joints, and towards obtaining a natural and stable gait when the new limb is fitted. The three stages are: (1) in bed; (2) in the department; and (3) on going home.

*Treatment in Bed.* If there are no complications, some patients can start treatment forty-eight hours after the leg has been amputated, but this is a matter for the surgeon in charge of the case to decide. For the first treatment the patient must have explained to him that flexion and adduction of the hip-joint are to be guarded against, so that he can gradually assume a good position in bed, and discard in a few days the pillows that will at first be supporting the stump in flexion. During the next few treatments he can learn to do gluteal contractions lying flat in bed, and quadriceps contractions if the knee-joint remains, and can then progress to extension, abduction and adduction of the hip, in side-lying and prone-lying.

It is as well to remember at this stage that when the patient gets up and begins to get about on crutches, the uninjured leg and foot will have double work to do and must not be allowed to get flabby. If there is any likelihood of this, faradism and exercises to the quadriceps of this leg and to the foot should be included in the treatment.

The physiotherapist should see that the patient has a suitable shoe ready for the time when he will begin to get up. The shoe should be well balanced with a low heel, and not a new shoe with a slippery sole. The patient should also be measured for a pair of crutches, lying flat on the bed with the shoe on, the measurement being taken from the axilla to level with the heel of the shoe. Until the patient can walk steadily and with confidence, the ordinary two-bar crutch should be used. Later, he should progress to the elbow crutch (Fig. 61).

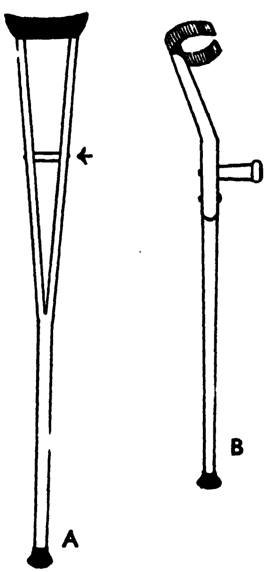

FIG. 61 —A. TWO-BAR CRUTCH. B. ELBOW CRUTCH.

*In the Department.* The next stage begins when the scar is healed; the patient is allowed to come down to the exercise department for treatment. The first thing to do is to teach him to stand between his crutches in a good position, so that he feels stable and confident. The next thing is to teach him to walk, taking short steps with his good leg and swinging his stump in line with, and in time with, his crutches, with his (imaginary) heel going down firmly first. If swinging the stump is insisted on from the beginning, the patient will not get into the bad habit of carrying his stump rigid and flexed at the hip. Incidentally, it is better always to refer to the stump, in speaking to the patient, as "your right (or left) leg," so as to make him retain the idea of using a whole leg.

Between the periods of walking, which should be very short at first so as not to over-tire the good leg, exercises should be given, extension, abduction, adduction, circling and swinging of the hip, and extension of the knee (if the knee joint remains). These may be done in the following starting positions :—

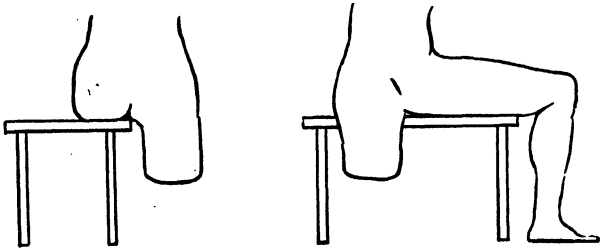

FIG. 62.—HALF-SITTING. THE PELVIS IS PARTLY FIXED.

1. Lying, side-lying, prone-lying.
2. Half sitting (Fig. 62).
3. Standing—between crutches, or parallel bars, or holding wall-bars.
4. Hanging from boom—(double-sided exercises).

Wherever possible the exercises should be given to both legs, with the idea of getting the patient to use the body as a whole and not to regard the stump as a useless appendage.

The exercises can first be done free, then against graduated resistance, given either by the physiotherapist or by some form of weight-and-pulley apparatus (Fig. 63).

When the stump grows less painful, it should be firmly bandaged every day, to help to get it firm and well shaped, in preparation for wearing an artificial leg.

Several patients of the same sex can be given their exercises all together as a class, after they have had a certain amount of individual treatment and have gained some idea of what is being aimed at. Exercises to music and competition from other patients are a great encouragement.

*On Going Home.* When the time comes for the patient to be sent home, the necessity of continuing to practise the exercises must be impressed on him, and also of keeping up his good habit of swinging the stump as he walks. He should be encouraged to return to work at once if this is at all possible, and not to wait to do so until his artificial leg can be fitted. All the exercises can be done at home, substituting the bed-rail for wall-bars and other apparatus.

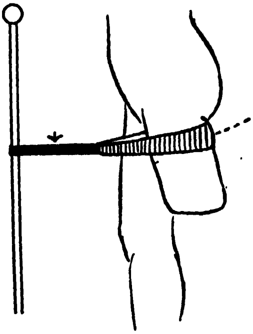

FIG. 63. — RESISTANCE APPARATUS OF STRONG ELASTIC, AND LOOP OF MATERIAL ATTACHED TO BEDPOST.

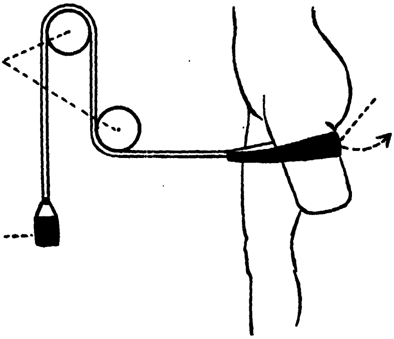

FIG. 64.—WEIGHT AND PULLEY APPARATUS, GIVING GRADUATED RESISTANCE.

# PART II

## CHAPTER XVIII

INFLAMMATION :—Causes—The natural process of repair—The process of inflammation—The terminations—Chronic inflammation—Suppuration. THE HEALING OF WOUNDS :—By first intention—By second intention or granulation—History of treatment of Wounds—Scar tissue—Tubercular inflammation of bone—Tuberculous disease of the spine.

"INFLAMMATION is the succession of changes which occur in a living tissue when it is injured, providing the injury is not of such a degree as to at once destroy its structure and vitality" (*Burdon Sanderson*).

The following are some of the causes :—

(*a*) Direct violence, *e.g.* a blow ; (*b*) changes of temperature, *e.g.* excessive heat causing burns of the skin, intense cold resulting in frost bite ; (*c*) electricity, *e.g.* lightning or injudicious X-rays ; (*d*) bacteria ; (*e*) chemical irritants.

Inflammation is the natural process of repair of living tissues, and must be distinguished from suppuration, which is a complication, and will be explained later.

The signs of inflammation which can be seen and felt or described by the patient are :—pain, swelling, redness, heat, and loss of or impaired function. These are known as the clinical signs.

The process of inflammation is usually divided into two stages ; (*a*) hyperæmia ; (*b*) exudation.

*Hyperæmia, i.e.* an extra supply of blood to the part. To begin with, the blood-vessels dilate, first the arteries, then the capillaries, and then the veins. While dilatation of the blood-vessels is going on, the blood-stream increases in speed. So there is a condition of dilatation and quickened flow. Along with these changes come two of the clinical signs mentioned above, viz., redness and increased heat. The inflamed part feels hotter because a greater amount of blood passes through it in a given time.

As the inflammation increases, the blood-stream next becomes slower; it slackens first in the veins, then in capillaries, and then in the arteries. Finally it stops, and there is a condition known as *stasis*. There is still dilatation of the blood-vessels. Sometimes the dilatation is so extreme that the vessels burst.

*Exudation, i.e.* an oozing out of fluid. While the above changes are occurring, the fluid part of the blood, known as liquor sanguinis or plasma, is oozing through the vessel walls into the surrounding tissues, causing a swelling or œdema of the part. This is a third clinical sign. The swelling will cause a stretching of the skin and pressure on the nerves, giving rise to pain, a fourth clinical sign. This exuded fluid is called inflammatory lymph. It is not the same as that within the lymphatic vessels. It is only found when a part is inflamed.

Together with the exudation of plasma there is migration of white blood corpuscles from the vessels into the surrounding tissues. The white corpuscles are continually changing their shape. They send out minute processes called pseudopodia, and by means of these they push their way through the vessel walls. They then wander about the inflamed area, and are known as phagocytes. If the inflammation is very severe, red corpuscles may also be exuded.

The inflammation has now reached its height, and the following conditions are present:—

1. Dilated and sometimes ruptured blood-vessels.
2. A slow blood-stream or stasis, which takes place first in the veins.
3. Exuded inflammatory lymph.
4. Multiplication of connective-tissue cells.

The clinical signs will still be present, and the patient will also show general symptoms as a result of the inflammation. There will be a rise of temperature, 99° F. to 101° F. A general feeling of discomfort combined with headache and loss of appetite.

## THE TERMINATIONS OF INFLAMMATION

These may take place in one of the following ways, according to the severity of the original injury.

1. *Resolution.* The cause of the inflammation is removed and the tissues return to their normal condition. To attain this end the following changes take place :—

(*a*) The inflammatory lymph is absorbed by the lymph-vessels.

(*b*) The white blood cells mainly return to the blood-stream or are carried away by the lymphatics. Some of them die.

(*c*) The red cells die and disintegrate. Their colouring matter is shown in parts which have been inflamed.

(*d*) New cells take the place of old ones.

2. *Chronic Inflammation.* The blood-vessels remain dilated for a longer time. The lymph is still poured out, new cells are being continually formed. This gives rise to overgrowth of fibrous tissue, and function of the part is impaired. It also may remain swollen, hot, and painful.

3. *Suppuration.* This condition is always caused by the presence of micro-organisms.

Such micro-organisms are pyogenic or pus-forming. By their growth they have the power of liquefying the tissues, and causing the white blood cells to die. The cells of the inflamed tissues die too, and so the whole area becomes filled with a liquid which is called pus, in which float dead cells. The pus will continue to form so long as the micro-organisms are living, and in the case of an abscess until it can reach the surface, when it bursts and discharges its contents. If this does not occur, it is often necessary for the abscess to be opened by the surgeon.

## THE HEALING OF WOUNDS

" A wound is the solution of continuity of any tissues of the body, in which the skin participates. If there be no solution in continuity of the skin, but the deep tissues are lacerated, there is a contusion or bruise " (*Howard*).

It is now necessary to explain how inflammation takes part in the natural process of the healing of a wound.

Wounds heal in two ways : (*a*) by first intention ; (*b*) by second intention or granulation. Under the second heading must be mentioned healing under a scab or blood-clot.

*Healing by First Intention.* This takes place when a wound is in an aseptic condition. Inflammatory lymph is poured out, binding the edges of the wound together. Multiplication of

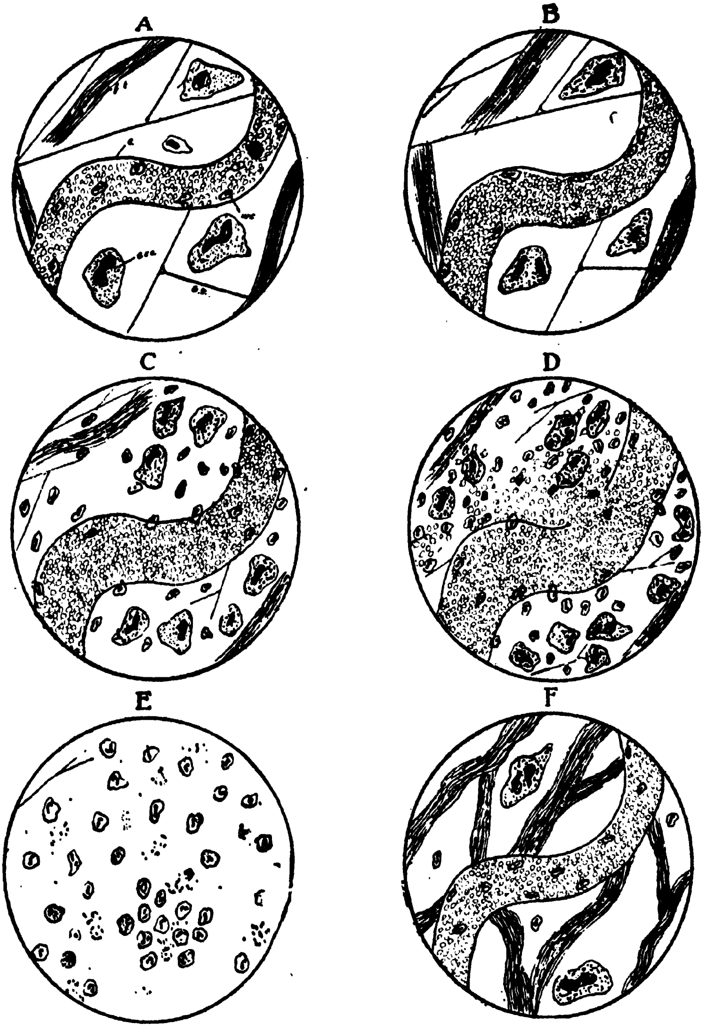

Fig. 65.—Diagram of Changes in the Blood-vessels and Tissues due to Inflammation.

A. Normal capillary blood-vessel and connective tissue: *ft*, fibrous tissue; *ct.c*, connective cell; *wc*, white blood corpuscle; *c*, capillary; *el*, elastic tissue.

B. First change. Dilatation and congestion of blood-vessel; the white cells arranged along the sides of the vessel wall; exudation of serum.

C. Second change. Blood-vessel, dilated and congested; exudation of white cells (phagocytes); multiplication of fixed connective-tissue cells; fibrous and elastic tissue indistinct.

D. Third change. Rupture of the congested vessel and escape of red corpuscles; multiplication of connective-tissue cells; normal tissue very indistinct.

E. Pus. Breaking down of the whole tissue, due to the presence of micro-organisms; suppuration.

F. Chronic inflammation. Blood-vessel small; great increase of fibrous tissue.

*From Howard's "Surgical Nursing," by permission of E. Arnold & Co.*

connective-tissue cells occurs, and new capillary loops are formed from the sides of the wound, which branch and spread among the new connective-tissue cells. These cells together with the capillary loops form granulation tissue within the wound. The cells increase in number; they stretch across the sides of the wound, uniting them, and by degrees they contract somewhat, causing the edges of the wound to be drawn closer and closer together. The new capillaries become nipped, and finally they disappear.

*Healing by Second Intention or Granulation.* This takes place when it is impossible to draw the edges of a wound together, when its condition is not aseptic, or if the wound is kept open by extravasated blood.

In any of these conditions much fluid is discharged upon the surface. If the wound is aseptic the fluid is inflammatory lymph. If it is septic it is pus.

The same formation of granulation tissue takes place as is described in healing by first intention. The granulation tissue eventually fills up the wound, and in time epithelium grows over it. These granulations become fibrous, and form scar tissue.

## TREATMENT OF WOUNDS

It is of interest to recall here that in the sixteenth century Ambroise Paré taught the need of cleansing wounds and removing foreign bodies from them. He also realised that nature repaired the tissues. He said of a patient: "I dressed his wounds; God healed them." In the nineteenth century Lister discovered that wounds became infected by bacteria, and he introduced the use of antiseptics and aseptic measures. Lister's discoveries and teaching were the beginning of the modern treatment of wounds, while it must also be realised that Paré's truth of allowing nature to heal is the basis of the present-day "closed plaster" treatment, which covers the wound and leaves it alone to rest.

It was towards the end of the first Great War that Winnett-Orr, a Canadian surgeon, began to treat patients suffering from severe wounds in a special way. First he thoroughly cleansed the wound and also cut away devitalised tissues. Then he packed the wound with sterile gauze and vaseline, and enclosed the whole limb in a casing of plaster of Paris.

The method has been further elaborated by the Spanish surgeon, Josep Trueta, during the civil war in his country, and used in our own hospitals during the last war.

This closed plaster has proved to be a satisfactory method of fulfilling complete rest and adequate drainage. The discharges from the wound are allowed to soak into the plaster. This in time produces an unpleasant smell, but such a disadvantage is outweighed by the success of healing obtained by the method.

It is well known that tuberculosis is healed by placing the affected parts at rest. The closed plaster does the same for wounds.

The plasters are changed from time to time, the first generally after a fortnight, and then at intervals of 3 to 6 weeks.

## SCAR TISSUE

" A scar is a mass of fibroid tissue covered by epithelium which has been formed in the repair of a wound. It is at first vascular, and contains cells of the connective-tissue type ; but after a time, as contraction continues, the cell elements become flattened out, fewer in number and less obvious, the intercellular fibrous tissue more abundant, and the vessels constricted, so that finally a scar becomes well-nigh bloodless. Where superficial its colour changes from red to white, and if of small size it may almost disappear, but never absolutely, unless the subcutaneous tissue has not been involved. Lymphatics, nerves, hairs, and cutaneous glands are all absent in scar tissue " (*Rose and Carless*).

Large areas of skin are affected by scar tissue as the result of burns, shrapnel wounds, and as the result of sepsis.

Massage is often ordered for such cases. Oil should be used as a lubricant. Friction is the only manipulation possible, but this may be of great benefit ; and if the affected areas are near a joint, passive movements may be given to improve mobility and stretch contractions in the skin.

## TUBERCULAR INFLAMMATION OF BONE

Every physiotherapist in the course of her work will come across patients suffering from tuberculosis in various forms.

Such cases are not treated by massage when the disease is active, but it is important to have some knowledge of the complaint. Any part or organ of the body may be affected by tuberculosis. It is due to the tubercle bacillus which was discovered by Koch in 1882. The disease, however, has been known from the very earliest times. Hippocrates (460–375 B.C.) first used the term "phthisis," and this word still designates tuberculosis of the lungs. The disease is very common. It has been stated that one-seventh of mankind die from it.

A tuberculous abscess may be present wherever tubercle can be deposited. The usual process of inflammation takes place and pus is formed, but this is of a different nature from that found in an ordinary abscess, and it contains the tubercle bacillus. Such abscesses occur mostly in connection with bones, joints, and lymphatic glands.

When the disease affects the ends of long bones it usually begins in the epiphysis or under the articular cartilage. Sometimes it burrows along the epiphyseal line and reaches a neighbouring joint, or the whole of the cancellous tissue may be affected. The joints themselves are attacked, either the synovial membrane, articular cartilage, or all structures combined.

*Symptoms.* General ill-health. High temperature, aching, and pain on movement. Wasting of the muscles. Impaired mobility.

*Treatment.* Rest. Attention to general health. Various appliances are used to keep the limb immobile. Massage is forbidden in the early stages. Six months or more after the disease is arrested it may be used together with cautious movements, the aim being to strengthen muscles and improve mobility in the joints. The movements require great care, and should not be forced.

## TUBERCULOUS DISEASE OF THE SPINE, ALSO CALLED SPINAL CARIES, POTT'S DISEASE, AND ANGULAR CURVATURE

This disease was first accurately described by Percival Pott in 1779.

It is due to tuberculous disease in the bodies of the vertebræ, which become more or less destroyed. The bones sink upon each other, and an angular curve is the result. The severity of the curve depends upon the number of bones which are attacked.

*Early Signs and Symptoms.* Pain in the back, specially after standing or walking. There are also referred pains according to the seat of the disease. Stiffness of the spine. (This is specially noticed if the patient stoops to pick something off the floor. The whole body is rotated.) Tenderness to pressure over the spines of the diseased vertebræ. High temperature. Disturbances of circulation and respiration. Sometimes there is paraplegia, owing to pressure on the spinal cord; this generally recovers if the abscess breaks down.

*Later Signs and Symptoms.* Deformity and bony ankylosis of the part of the spine affected by the disease.

*Treatment.* Absolute rest. A plaster of Paris jacket is usually applied and the patient is nursed in a recumbent position for from 6 months to 2 years or more.

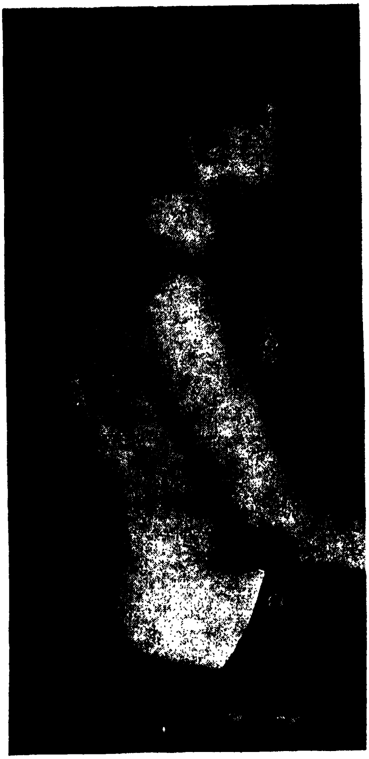

FIG. 66.—ANGULAR CURVATURE, CAUSED BY CARIES OF THE SPINE.

*From a photograph lent by Mr. Jackson Clarke.*

In the early stage the only massage allowable is gentle manipulation of the arms and legs, viz. effleurage and kneading. Later, not before six months after the disease is arrested, gentle back massage may be added. Breathing exercises are helpful to improve respiration and the mobility of the thorax.

# CHAPTER XIX

**Fractures** :—Varieties of fractures—Displacement of bones in fractures—Epiphyses and diaphyses of bones—Traumatic separation of an epiphysis—The union of fractures—Ununited fractures—The signs and symptoms of fracture—Brief history of treatment of fractures—First aid—The treatment by massage and active movements—Stages of treatment—The use of plaster of Paris—Exercises in plaster—*Treatment of special fractures of upper extremity*—The clavicle—The humerus—The anatomical neck—The surgical neck—The shaft—The supra condylar—Other fractures in or near the elbow-joint—The olecranon process—The bones of the forearm—Colles's fracture—*Treatment of special fractures of lower extremity*—The neck of femur—The shaft of femur—The patella—Pott's fracture—The tibia and fibula—The bones of the foot—Re-education in walking after leg injuries—Fracture of the pelvis—Spinal column—Coccyx.

A FRACTURE is the sudden solution of continuity in a bone. The conditions and influences which are responsible for fractures are many and various. Age is a factor which must be considered, for the strength and elasticity of bones vary considerably at different periods of life, also exposure to injury is very variable. Children are liable to fractures on account of frequent falls. Fractures are commoner in boys and young men than in girls and women of the same age, because they lead a more exposed life, but after forty-five years women are particularly liable to fracture the neck of the femur, and also to Colles's fracture. The bones of old people are very liable to fracture, as they become brittle.

Fractures may occur owing to some morbid condition of the bone, but by far the largest number are of traumatic origin, *i.e.* due to injury.

These may be the result of :—

(*a*) *Direct violence, e.g.* a wheel passing over a femur.

(*b*) *Indirect violence ;* (1) the bone gives way at a distance from where the force is applied, *e.g.* a fall on the hand that fractures the clavicle. (2) *Muscular action.* This is commonly the cause of fractures of small bones or prominences

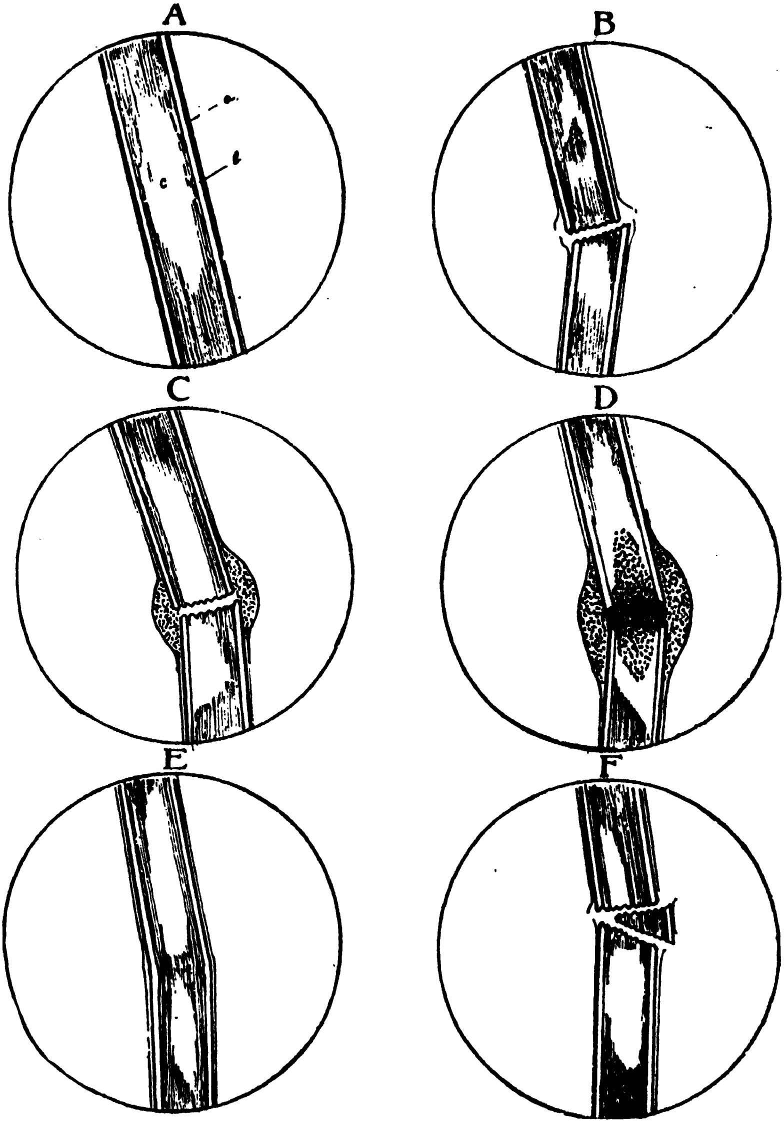

FIG. 67.—DIAGRAM OF UNION OF A SIMPLE FRACTURE.

A. Normal bone—*a*, periosteum ; *b*, compact tissue : *c*, medullary cavity.
B. Fracture, periosteum torn.
C. Formation of temporary callus, periosteum joined.
D. Temporary and permanent callus.
E. Bone united with some deformity.
F. Comminuted fracture.

*From Howard's " Surgical Nursing," by permission of E. Arnold & Co.*

into which powerful muscles are inserted, *e.g.* the sudden contraction of Quadriceps causing fracture of the patella. Also a sudden contraction of the Triceps causes fracture of the olecranon.

## VARIETIES OF FRACTURES

*A Simple Fracture,* also called a *Closed Fracture,* is one in which the skin is unbroken.

*A Compound Fracture,* also called an *Open Fracture,* is one where there is a wound leading to the site of the fracture. The broken fragments of bone are in communication with the air.

*A Complete Fracture* is one when the continuity of the bone is entirely interrupted. It may be *transverse, oblique, spiral, longitudinal, simple, compound, comminuted*—the bone is broken in more than two pieces. *Impacted*—one fragment is driven into another. *Complicated*—important structures such as an artery or joint are damaged as well as the bone.

*An Incomplete Fracture* is one when the continuity of the bone is not entirely interrupted. (*a*) *Greenstick.* This occurs only in children. The bone is bent and partly broken. There is the same effect as when a green twig is broken across the knee.

(*b*) *Fissured.* The bone is merely split. No displacement is caused.

*A Double Fracture* is one where the bone is broken in two places.

*A Depressed Fracture* is only seen in a fractured skull.

## DISPLACEMENT OF BONES IN FRACTURES

*Angular.* This may be forwards, backwards, or sideways. It is usually backwards in the tibia.

*Longitudinal.* One fragment overlaps the other or is forcibly driven into it, causing shortening of the limb.

*Lateral.* The displacement is to one side or the other. There is often delayed union in this form.

*Rotatory.* The lower fragment is twisted on the upper, as in fracture of the femur, where the weight of the limb causes eversion of the foot.

### Epiphyses and Diaphyses of Bones

An epiphysis is the articular end of a bone, and the diaphysis is the shaft. In fœtal life these are cartilaginous, but bony centres appear in them from which the bones gradually ossify.

During growth the epiphysis remains separated from the shaft for a definite time by a layer of cartilage. This is known as the epiphysial line. Growth of bone takes place at this line ; and when the epiphysis becomes united to the diaphysis and the line of cartilage is obliterated, growth ceases, and the bone assumes its complete form.

### Traumatic Separation of an Epiphysis

This occurs in people under twenty-two years of age. The separation occurs at the epiphysial line. The ends of the femur, humerus, and radius are the bones most often affected. The condition is often accompanied by one or more slight fractures near the separation.

### The Union of Fractures

In order to understand the changes which take place when a bone is fractured, we must first study its structure.

The shaft of a long bone is hollow, and formed of hard or compact tissue. The ends of the bones are encased in hard tissue, but within they are composed of a loose network of bone substance known as cancellous tissue. The hollow part of the bone is called the medullary cavity, and it contains marrow. Covering the outer surface of the bone is a firm, tough, fibrous membrane—the periosteum ; and it is from this membrane that the bone derives its blood supply. The periosteum also has an important function to fulfil in the healing of a fracture.

Immediately after the fracture takes place, there is bleeding around, and the broken fragments become embedded in a blood-clot. The periosteum is torn. The injury sets up inflammation and is followed by the formation of a mass of soft tissue known as callus.

Callus is derived from the periosteum and for the sake of clearness as to its position it is called (*a*) permanent callus, *i.e.* that lying between the broken fragments ; (*b*) ensheathing callus, *i.e.* that lying beneath the periosteum, but outside the broken fragments; (c) internal callus, *i.e.* that which temporarily fills up the medullary cavity in the region of the fracture.

In about a week after the injury the blood clot has disappeared, bony salts are gradually deposited, and the callus begins to harden. The hardening continues until there is complete union of the bone. The time in which union takes place varies according to the size of the bone, the amount of separation and displacement, the vascularity of the part, and also the recuperative powers of the patient. In straightforward conditions the radius unites in about 7 days, the humerus in about 12 days, but the femur requires a month or more.

The better the bones are set or placed in apposition, the more perfect will the union be. By degrees the ensheathing and internal callus becomes absorbed, the medullary cavity reopening. By the end of a year it is often impossible to tell that a bone has been broken.

### UNUNITED FRACTURES

There are three varieties of ununited fractures:—

(*a*) When there is no union at all.

(*b*) When there is fibrous union, *i.e.* the fractured surfaces are closely united by fibrous tissue. In this form very little callus is formed, and no bone salts are deposited.

(*c*) A false joint. When this occurs there is no union between the fractured surfaces, but the ends of the bones are surrounded and united by a ring of fibrous tissue, forming a false capsule. No synovial membrane or cartilage is present.

### THE SIGNS AND SYMPTOMS OF FRACTURE

*Signs.* Swelling, bruising, loss of power, deformity, abnormal mobility and crepitus.

*Symptoms.* Pain and great tenderness. The patient suffers from shock, according to the severity of the injury, and the temperature rises to about 100°.

*Early Treatment.* When an accident has taken place, first aid must be rendered. It is essential that the injured part is supported with great care and that the patient is removed to hospital as speedily as possible.

The injured limb is first X-rayed and then the fracture is "set." The process consists of reducing the deformity and placing the fractured bones in a normal position and fixing them. This is accomplished by the skill of the surgeon, who adapts his methods according to the injury with which he has to deal. It is essential that, (*a*) the fracture is immobilised together with the joints immediately above and below the injury, until bony union has taken place, and (*b*) that other joints are left free during the fixation, so that they may be exercised. Plaster of Paris is applied, or suitable splints and apparatus made for the purpose.

## A BRIEF HISTORY OF THE TREATMENT OF FRACTURES

Since the dawn of civilisation fractures have been treated with considerable care and efficiency.

Discoveries in Egypt have shown that in the year 2000 B.C. fractured bones were so treated that they healed in good position. There is also evidence that moulded splints were in use at that time.

Hippocrates (380 B.C.) wrote a treatise on fractures and dislocations. He showed the importance of early reduction and the value of continued traction for a broken bone. In the sixteenth century Ambroise Paré, the great French surgeon, carried on the principles which Hippocrates had laid down.

In the seventeenth century, Jean Louis Petit, another Frenchman, and John Aitkin, of Edinburgh, were famous for their treatment of fractures. In the eighteenth century Percival Pott was a surgeon of St. Bartholomew's Hospital. His name is carried down by the fracture dislocation of the ankle, while a little later Abram Colles, of Dublin (*d.* 1843), first described the wrist injury which bears his name.

Hugh Owen Thomas lived early in the nineteenth century. For many years he treated serious injuries among the industrial workers of Liverpool, devising and making splints which are used up to the present time. He was followed by his nephew,

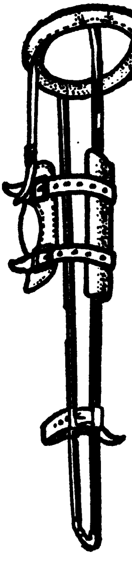

FIG. 68.—THOMAS' SPLINT.

From Textbook of Orthopædic Nursing. Evelyn E. Pearce. *By permission of Faber and Faber, Ltd.*

Robert Jones, whose great reputation during the 1914 War is well known.

The present century has seen many changes in fracture treatment, both in principle and practice.

The use of Röntgen rays have greatly increased the precision of diagnosis and the carrying out of correct treatment.

At one period Arbuthnot Lane, of Guy's Hospital, introduced internal fixation of fractures by plating the bones, but the method is now not much used.

Open operation for fracture of the patella and olecranon process by wiring has also been practised for a considerable time, but it is now more usual for the surgeon to remove the fragments of bone and suture the tendons in these cases.

In the year 1895 Lucas Championnière, of Paris, introduced his method of treating fractures by massage and mobilisation, and the principles of his teaching have been carried on by Dr. Mennell of St. Thomas's Hospital.

Except in cases of serious deformity, Championnière used little or no splinting, and he employed massage and movements from the day of injury. His system, however, did not become the routine of all fracture treatment, though some of his principles are still incorporated with the teaching of the present-day.

For about forty years massage and movements have been very largely used in this country, but recently the application of plaster of Paris has altered the technique in the treatment of many fractured bones. This is largely due to the teaching of Lorenz Böhler, of Vienna, and his methods and principles have been adopted by many leading surgeons. Further mention of this will be made, but the routine methods by massage and active movements must be given as before, for they are fundamentally important in the students' training.

It is now usual to segregate patients suffering from fractures. By this means continuity of treatment is made possible, from the time of injury until there is complete restoration of function.

Fracture clinics are established for this purpose in hospitals and other centres, staffed by skilled workers and equipped with necessary appliances.

Massage may be ordered, but in any case it is the rôle of the physiotherapist to secure the active co-operation of the patient and teach him how to help in his own recovery. It is important that all students should have practical experience in this branch of their work during training.

### First Aid

This is a special branch of work, but the knowledge is of value to all and should be included in the curriculum of every physiotherapist. Hæmorrhage may be arrested, shock treated, and fractures carefully handled by a first-aid worker, but the patient should be removed to hospital as soon as possible.

### The Treatment of Fractures by Massage and Active Movements

During all stages of the treatment the following facts must be considered :—

(*a*) The age and general condition of the patient.

(*b*) The severity and site of the injury. If a joint is involved, *i.e.* the fracture has extended to that part of the bone within the joint capsule, greater caution is required.

(*c*) The size of the fractured bone and the time in which union normally occurs in such a bone.

(*d*) The changes taking place with regard to the formation of callus.

(*e*) The healing of the soft tissues.

During all treatment the patient's comfort must be considered, and the limb supported so that there is complete relaxation of the part, *and it is of the greatest importance that the fractured portions of bone must not be disturbed.*

#### STAGES OF THE TREATMENT

FIRST STAGE. From the time of the injury until the bone is united by callus. During this period the fracture is considered *recent.*

Objects of treatment are : (*a*) To soothe pain. (*b*) To relieve muscle spasm. (*c*) To prevent adhesions. (*d*) To maintain alignment of fragments.

*Massage and Movements.* The massage must be very light and rhythmical, and consist of effleurage and light kneading.

This is first done above the injured part. Gradually the hand is allowed to encroach upon the injury and finally to pass very lightly over it. Such massage is given daily for 15 to 20 minutes.

About the second or third day (after the injury) active movements are begun. These are done by the patient to a small degree and *within the limit of pain,* beginning in the joints distal to the injury; later they are done in the proximal joints. Such movement is difficult at first owing to weakness, but the masseuse supports the limb and helps. It is therefore known as *assisted active movement.*

SECOND STAGE. This extends from the time when the bone is united by callus, until it is consolidated, and there is full restoration of function in the limb.

*Massage and Movements.* The treatment is now gradually increased. Friction round joints is given, deeper muscle kneading and petrissage are added.

Active movements are done as before, gradually extending the range and including all joints of the injured limb. These should be performed freely and with some resistance until full movement and strength is restored.

The patient must be encouraged to do small movements by himself.

If the injury is to the upper extremity, he is urged to move his arm, and to use his hand for small things and gradually increase to large.

If the injury is to the lower extremity, massage and movements may be given as above. In such cases the leg often becomes œdematous, and the work of the physiotherapist is much helped by the limb being raised for twenty minutes before treatment, and the massage then given should be deep and fairly vigorous.

The time is somewhat variable as to when the patient may attempt walking. Many, however, are allowed the use of crutches. It is usually six to eight weeks or longer before the patient can bear the weight of the body on the injured limb (and much longer for an adult femur).

In the chronic stage the treatment of every fracture varies, and much depends upon the skill of the physiotherapist and her methods of helping the patient to recover the movements which have been lost.

### The Use of Plaster of Paris

The use of plaster of Paris was first introduced by a Dutchman about the year 1814. Ever since then it has been used, but modern methods of application have in recent years increased its value. Many surgeons now advocate its use for fractures. The principles of immobilisation by this means are:—

1. That after the broken fragments of bone have been placed in close and true apposition, the injured part is immobilised until the bone is firmly united.
2. The immobilisation is so carried out that during the healing period it is made possible for the patient to use the affected limb.
3. It is upheld that because the fracture is completely immobilised the patient is comparatively soon free from pain and muscle spasm is reduced. The object of using the limb during its encasement is to prevent joint stiffness and muscle wasting, and also to accelerate the circulation.

### Exercises in Plaster

The patient must be instructed to frequently exercise the joints which are not immobilised, and to carry the movements to their full limit.

*In the upper extremity* the fingers and thumb are bent and stretched, and shoulder and elbow movements carried out (see pp. 116 and 117).

The patient is told to carry on his or her normal activities as much as possible, *e.g.* the housewife may use a dustpan and brush, a duster, make beds, peel potatoes, etc. (but the plaster must be kept dry).

*In the Lower Extremity* (see pp. 73 and 74). When the lower leg and ankle is plastered, the patient should frequently bend and stretch the toes, also sit with leg over edge of a support, and swing the knee and actively bend and stretch it. Lying, bend and stretch the hip-joint.

The plaster is often so arranged that the patient can walk, thus enabling the muscles to carry out their usual work.

*Note.* If excessive œdema is present after a fracture has occurred the application of the plaster may be deferred until the swelling subsides.

## Treatment of Special Fractures of the Upper Extremity

### FRACTURE OF THE CLAVICLE

A clavicle may be fractured by indirect violence, but as it rests upon the first rib when the shoulder is fully depressed, it may give way across this bone in carrying heavy weights, etc.

The attitude of the patient in a recent case is characteristic. The elbow of the affected arm is supported with the other hand, and the patient inclines his head towards the broken bone.

After reduction a shoulder brace is usually applied. The site of the injury is supported by strapping and the forearm placed in a sling (St. John's), the knot being tied on the sound shoulder. Bony union begins to occur in 7 to 10 days.

*Massage* is not often required, but if necessary it may be given from the first.

*Movements* are done actively in fingers, wrist and elbow from the beginning, and about the seventh day rotation is begun in the shoulder, and other movements added gradually.

About three weeks after the injury exercises may be given to restore strength and full range of movement.

Suggested exercises :—

Crawling up wall with fingers, gradually abducting shoulder ; free double-arm flexion and extension ; arm swinging ; arm casting. Later, double-arm flexion and extension ; arm rotation.

### FRACTURES OF THE HUMERUS

This bone may be fractured in various parts and in many different ways.

### FRACTURE OF THE ANATOMICAL NECK OF THE HUMERUS

*An Intra-capsular Fracture.* This is usually caused by direct violence, as in a fall upon the shoulder, and is often accompanied by comminution of the tuberosities.

A pad is placed in the axilla, the joint protected by a cap, the arm bandaged to the side and placed in a sling.

*Massage* of the whole arm may be given from the first. Light effleurage only over the shoulder region.

*Movements.* Small assisted active movements may be done from the first in fingers, wrist and elbow. After 7 to 10 days the following are begun in the shoulder. A small backwards and forwards movement, and slight abduction. All done with care and much support. After two weeks inward and outward rotation is attempted. The massage is gradually increased and movements are by degrees carried to their full range. After three weeks crawling up the wall with the fingers should be practised, gradually abducting the arm; and to further recover inward and outward rotation the patient touches the back of his neck and places the dorsal surface of his hand on his back, gradually getting it up to the opposite scapula.

### FRACTURE OF THE SURGICAL NECK OF THE HUMERUS

Fracture of the surgical neck of the humerus is generally caused by a fall on the shoulder, elbow, or hand.

*Treatment.* There may be considerable displacement of the bone fragments which must be corrected by traction. The arm is allowed to hang vertically by the side of the body, so that the weight of the limb helps reduction by continuous traction. There must be no support under the elbow, but the wrist is held by a collar and cuff sling.

Sometimes the fracture has been impacted, and there is little or no displacement.

*Bone union begins to take place in* 8 *to* 12 *days.*

*Massage and Exercises if the Fracture is Impacted.* The patient lying with head and shoulders well supported, soothing massage is given from the first, and active movements in fingers, wrist and elbow. Very cautious assisted movement to the shoulder, the operator supporting with a hand above and below the joint. This must be given within the limit of pain, and gradually increased.

*If the fracture is not impacted* the treatment is given in the sitting position, the arm remaining vertical.

Soothing massage is given from the first and the patient instructed to exercise the wrist and fingers, but no movements are given in the shoulder before 10 or 12 days.

Special attention must be given to Deltoid from the first,

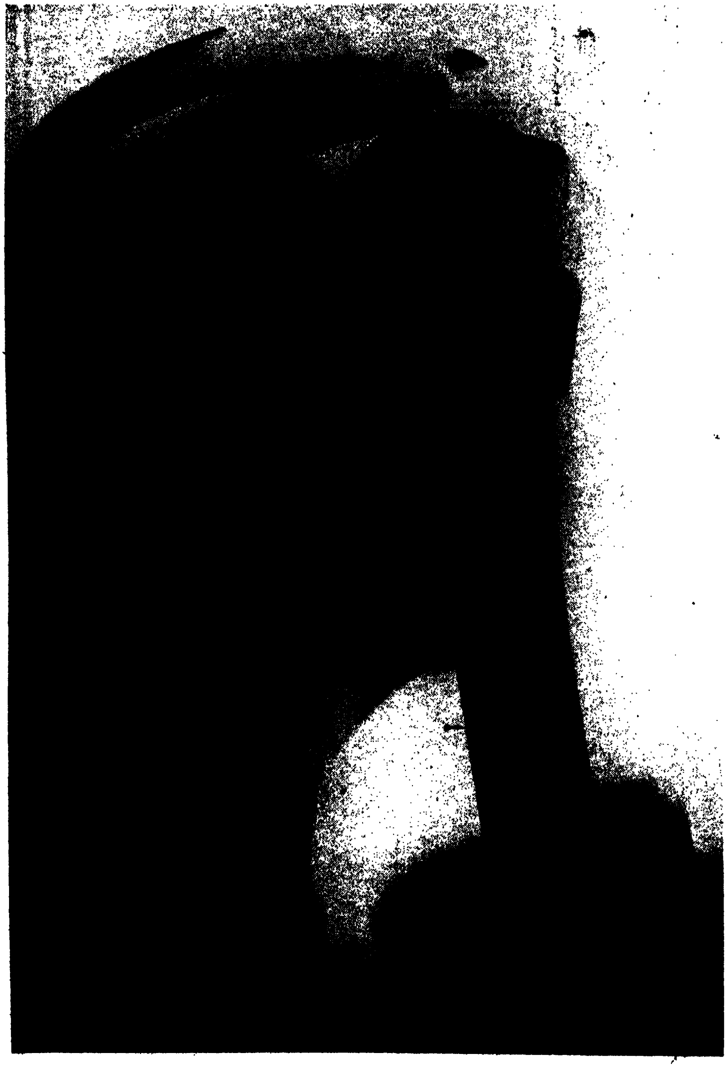

FIG. 69.—FRACTURE OF SURGICAL NECK OF HUMERUS IN YOUNG SUBJECT. EPIPHYSIAL LINE IS ALSO SHOWN.

*From a photograph lent by the Derbyshire Royal Infirmary.*

as it wastes quickly. The patient must be taught to gently contract the muscle.

Rotation is deferred till a week later, after other movements are begun, and all must be given with much support.

If suitable appliance is available, the forearm may be supported in a sling attached by an overhead cord and pulley while the movements are done.*

By degrees the massage is increased and movements in all joints are carried to their full limit. After three weeks the patient attempts crawling his fingers up the wall and placing his hand in positions to obtain normal abduction and elevation of the arm and also internal and external rotation.

### FRACTURE OF THE SHAFT OF THE HUMERUS

Fracture of the shaft of the humerus is a fairly common accident, and is due to direct or indirect violence. Sometimes the cause is sudden muscular contraction. It may take place at any point along the shaft.

This fracture is fairly liable to complications, a small fragment of muscle or connective tissue may pass between the broken ends of bone and cause great pain, and in some cases hinder union. The musculo-spiral nerve may be involved, resulting in the loss of power of the extensor muscles of the wrist which it supplies. The nerve is especially exposed to injury in the musculo-spiral groove, where it lies quite close to the bone. It sometimes becomes embedded in the callus of a fracture. This matter is further considered in the chapter on nerve injuries.

*Treatment.* After reduction, if this fracture is in the upper third of the bone, it may be placed on an abduction splint for three weeks. If the injury is in the middle or lower part of the shaft, gutter splints from shoulder to elbow may be used. The arm is placed in a sling, but the elbow is unsupported to allow of extension by the weight of the limb. If there is serious overlapping of the bones, traction is applied for 3 or 4 weeks. At the present day many surgeons prefer plaster splintage, which is applied according to the injury.

*Bone union begins to take place in 12 to 14 days.*

*Massage.* This may be ordered if movable splints are used, and if abducted the treatment is first given upon the splint.

If the arm is at the side, the splints are not removed for eight days, but after this time massage may begin. Bandages are removed and the arm is carefully supported on a cushion in front of the patient.

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* See p. 69, Mrs. Guthrie Smith's suspension apparatus.

*Movements.* These are given from the first in fingers and wrist which are left free. In a few days small movements should be done in the elbow, also pro- and supination. Careful shoulder movements may begin about the fourteenth day.

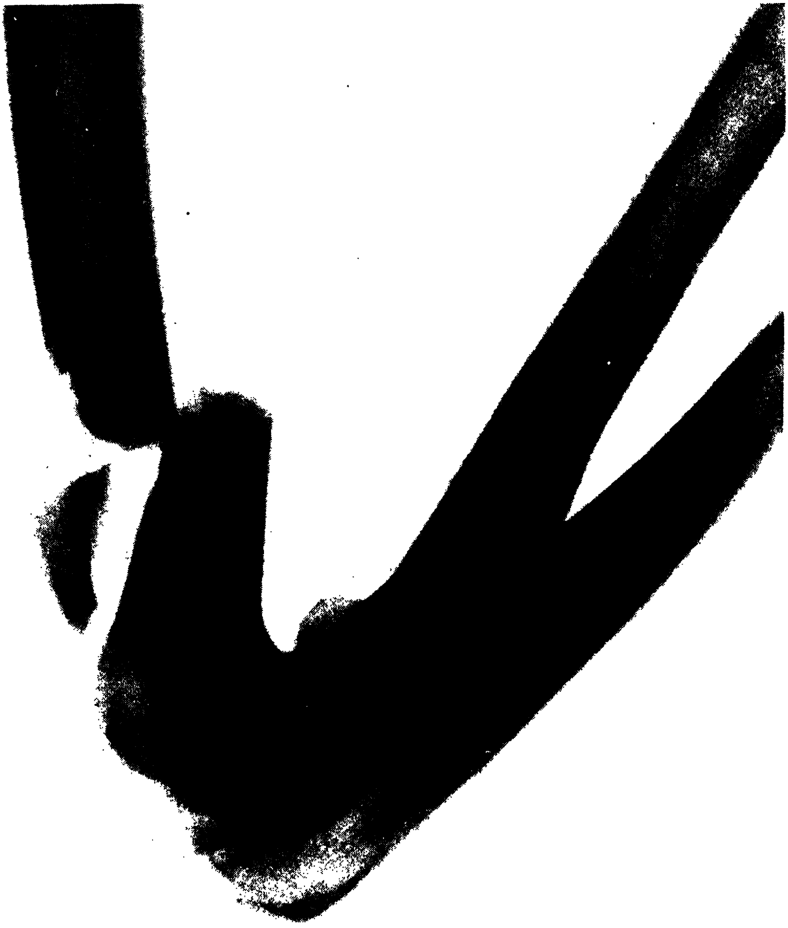

FIG. 70.—COMMINUTED FRACTURE OF LOWER THIRD OF HUMERUS. LATERAL VIEW.

*From a photograph lent by the Worthing Hospital.*

The physiotherapist must use discretion regarding these movements according to the position of the fracture. If in the upper half of the bone, elbow movement is allowed first and that in the shoulder delayed. If in the lower half the opposite is indicated.

Rotation in the shoulder is the last movement attempted.

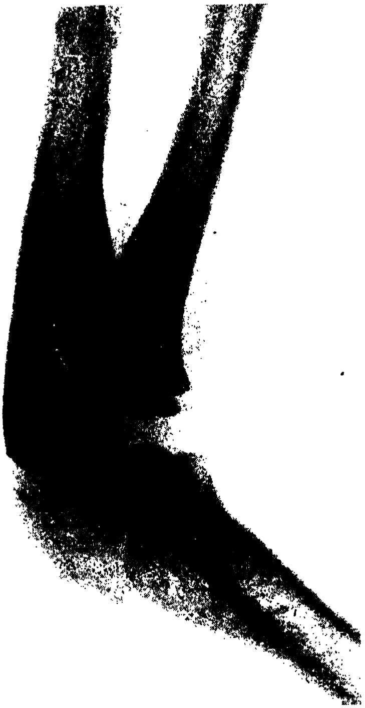

FIG. 71.—LATERAL VIEW. FIG. 72.—ANTERO-POSTERIOR VIEW.

The normal elbow of a child aged 10.

*From photographs lent by Mr. J. Magnus Redding.*

After the splints are discarded, a sling is worn and massage is increased.

All movements are gradually taken to their full range.

If *plaster* has been applied, the injury will be immobilised from 3 to 6 weeks. The shoulder or elbow may or may not be included, according to the site of the injury, but from the first the patient must be taught to move fingers and wrist, also elbow and shoulder if left free. Such movements require early supervision, but the patient continues them at home at frequent intervals. When the plaster is removed massage and exercises may be necessary for a short time to restore full movement and strength.

### SUPRACONDYLAR FRACTURE OF THE HUMERUS

This is a common injury in children and adolescents. It is seldom seen after the age of twenty.

At first the joint is often so swollen it is impossible to feel the bony outlines. Accurate reduction is of great importance and the surgeon generally requires a series of X-rays to be taken.

After reduction the elbow joint is placed in full flexion and supination. The same position is used as after elbow dislocation. Either a collar or cuff is applied with a supporting arm sling, or a plaster shell is laid on the posterior aspect of the arm, the collar cuff again holding the wrist.

*Massage.* None is allowed in the early stages.

*Movements.* The patient is taught to exercise fingers and wrist from the first. None in the elbow for 2 or 3 weeks.

After this time the arm is still carried in a sling and gradual active movements are taught. These are first done in lying position. Extension is attempted, but flexion must also be maintained by trying to touch chin, clavicle and shoulder.

Passive stretching of the joint should not be done. With perseverance movement is restored by the method described. All movements may be done actively in the shoulder.

### OTHER FRACTURES IN OR NEAR THE ELBOW-JOINT

Other fractures in the elbow region may be: (*a*) Fracture of the bone into the line of the joint. (*b*) Fracture of either condyle. (*c*) Separation of the epiphysis.

*Treatment.* For any of these injuries follow the same lines as that described for a supracondylar fracture.

### FRACTURE OF THE OLECRANON PROCESS

The injury is usually caused by direct violence, but sometimes by the action of the Triceps muscle. The fractured portion of bone is often completely separated from the shaft and drawn upwards by the spasm of the Triceps. In some cases the displacement does not occur, the fragment being held in place by fibrous tissue.

*Treatment.* This is usually surgical. The fractured portion may be wired to the shaft, but many surgeons prefer to remove the bone fragment and suture the tendon. The limb is usually placed in a right angle position and carried in a sling, but if there has been no separation and no operation it may be set in full extension on an anterior gutter-splint from hand to axilla. If this is the case the arm should not be

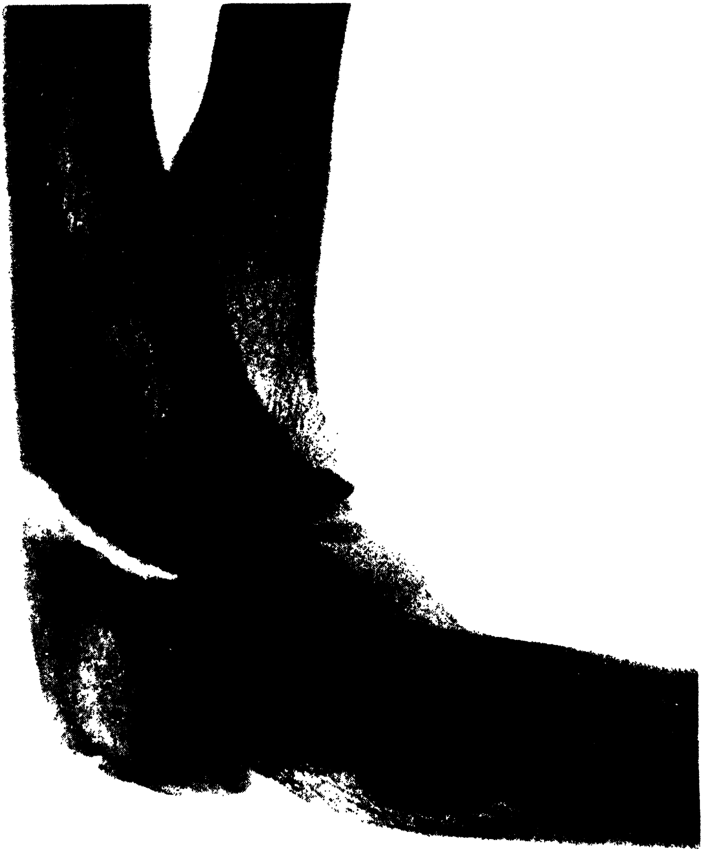

FIG. 73.—FRACTURE OF THE OLECRANON PROCESS.

*From a photograph lent by Mr. J. Magnus Redding.*

allowed to hang down for long periods, but be supported in abduction as much as possible. *If the plaster method* is used the limb may be encased from shoulder to knuckles either in semi-flexion or full extension for 4 to 5 weeks.

*Massage and Movements if Without Operation.* Light massage may be given from the first from hand to shoulder, with special attention to the Triceps. Movements must be taught and practised in the fingers and wrist from the first. About the tenth day begin cautious assisted movement in the elbow to a very small degree, supporting the joint and keeping the fragment pressed down. The massage and movements are gradually increased, but flexion must not pass a right angle for at least two weeks, and full extension or raising the arm above the head must not be done for at least three weeks after the accident.

*Note.* If complications have occurred movements must not be given without the surgeon's permission.

*If Treated by Operation.* Cover the wound and begin massage the fourth day after operation. Very slight and cautious movement in the joint may begin about the eighth day.

The massage is gradually increased and should include effleurage, friction and petrissage of muscles. The movements must also gradually increase, but flexion must not pass a right angle for at least two weeks. Again give movements to wrist and fingers from the first.

Aseptic precautions must be taken, and gentle manipulations given round the area of the scar to loosen it.

*If in Plaster.* Finger, wrist and shoulder movements must be taught, and the patient is urged to carry these out daily, every few hours.

If the arm is in extension, the following is useful: Make a bag of two layers of calico, placing cotton wool between the layers. The bag must be large enough to enclose the hand, and it is tied to the end of the plaster with tape. A piece of rubber sponge is placed inside the bag and the patient is told to continually squeeze it in his hand and fingers.

### FRACTURE OF THE BONES OF THE FOREARM

Fracture of the forearm bones is generally caused by direct violence. One or both bones may be broken.

*Treatment.* After reduction the fractured bones are usually *immobilised in plaster* in full supination. The elbow or wrist may be included according to the position of the injury.

*Union of the bones begins to take place in 8 to 14 days.*

*Movements.* The fingers will be left free, and the patient must be instructed to move them continually. Then he is urged to use the hand. This may be done as much as possible, though softening the plaster by contact with water must be avoided.

The plaster is worn for 6 to 8 weeks. When it is removed, massage is given if necessary and active movements until the full range is restored in fingers, wrist, radio-ulnar, elbow and shoulder-joints.

### COLLES'S FRACTURE

This is one of the commonest fractures. It occurs most frequently to elderly women, and it is generally due to a fall on the outstretched hand.

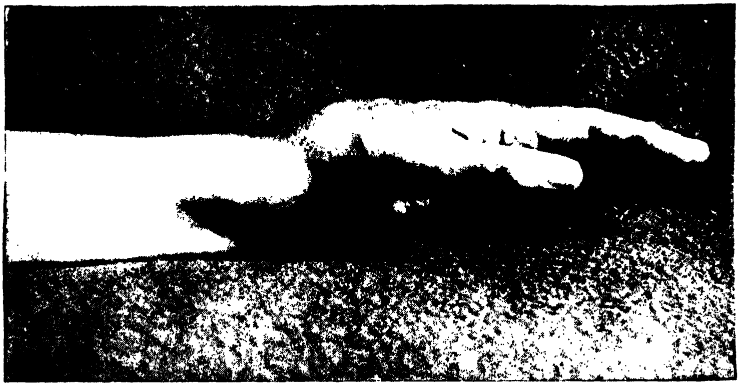

FIG. 74.—COLLES'S FRACTURE OF THE RADIUS, SHOWING THE TYPICAL "DINNER FORK" DEFORMITY, DUE TO "BACKWARD DISPLACEMENT AND TILTING OF THE LOWER FRAGMENT."

*From Fractures and Joint injuries by Sir Reginald Watson Jones, by permission of E. S. Livingstone.*

The fracture takes its name from an eminent Dublin surgeon who first described it.

The site of the fracture is at the lower end of the radius.

¾ inch above its articular surface. Frequently the styloid process of the ulna is severed, and the internal lateral ligament ruptured. The fractured portion of the radius is often impacted. It may be comminuted. " The lower fragment is driven backwards and upwards, and rotated to the radial side, carrying the hand with it into the position of abduction, and leaving the tip of the radius, at the same level as, or higher, than the tip of the styloid process of the ulna " (*Cunning*).

The displacement produces what is known as the " dinner-fork deformity." The lower fragment of the bone forms a swelling on the dorsum, just above the wrist-joint, and above it there is a sudden drop to the forearm level. The wrist and fingers hang slightly flexed.

*The bone begins to unite in 7 to 10 days.*

*Treatment.* Reduction by the surgeon should take place as soon as possible. The injury is then placed on some kind of movable splint or it is immobilised in plaster of Paris. The latter is the most usual procedure at the present time, but both forms of treatment will now be described.

*Treatment by Splinting, Massage and Movements.* After reduction the hand is placed on a Carr's, a gutter-splint, or a removable plaster moulding. The hand is firmly bandaged, but the fingers are left free.

*Massage* may begin from the first, but during *the first week* the arm is not lifted from the splint ; only bandages are removed.

Light effleurage is given, beginning above the injury, then passing gradually over it. Soothing massage to fingers and hand. This is done for 10 to 15 minutes and the bandage is firmly re-adjusted.

Then the patient is instructed how to move the fingers and thumb, and told to continue practising the movements.

*After one week* the limb may be lifted off the splint on to a firm cushion for treatment. Massage as before, adding light kneadings over wrist, hand and fingers. At this stage the arm must be turned to a position midway between pronation and supination, so that effleurage and kneadings may be given on the anterior surface of the wrist and forearm. The masseuse supports the wrist firmly and turns it with great care.

A small amount of flexion and extension of the wrist is now attempted.

*In seven to ten days* after the injury the splint is discarded, and the arm is carried in a sling for another week. Massage and movements are gradually increased till all active movements in the joints are given, viz.: Finger flex. and ext. Thumb flex. and ext. ab. and adduction, and opposition. Wrist flex. and ext. radial and ulnar flexion. Pronation and supination.

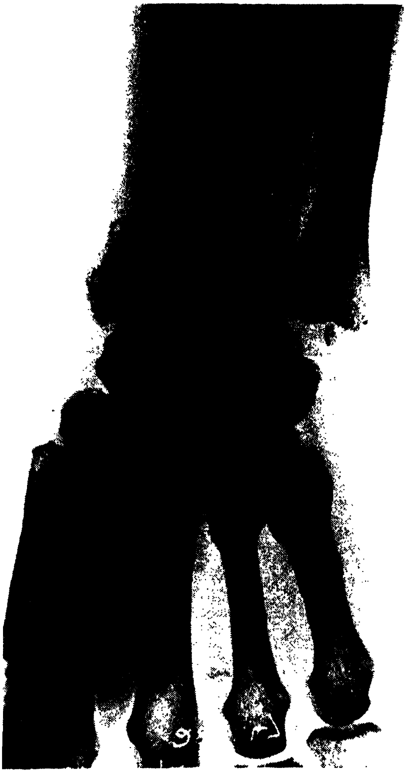

FIG. 75.—POSTERO-ANTERIOR VIEW.

FIG. 76.—LATERAL VIEW.

Colles's Fracture with comminution of lower end of Radius into the wrist-joint and fracture of Ulnar styloid. Before reduction. All classical deformities are shown in a marked degree.

*From photographs lent by the Worthing Hospital.*

The hand of the masseuse should firmly support the site of the fracture during movements in the wrist and finger joints.

Pronation and supination require special attention, but should not be given till about the fourteenth day.

*After three weeks* the patient is urged to use the hand and the treatment is continued until full range of movement and strength is recovered. This is generally accomplished in about six weeks from the time of injury.

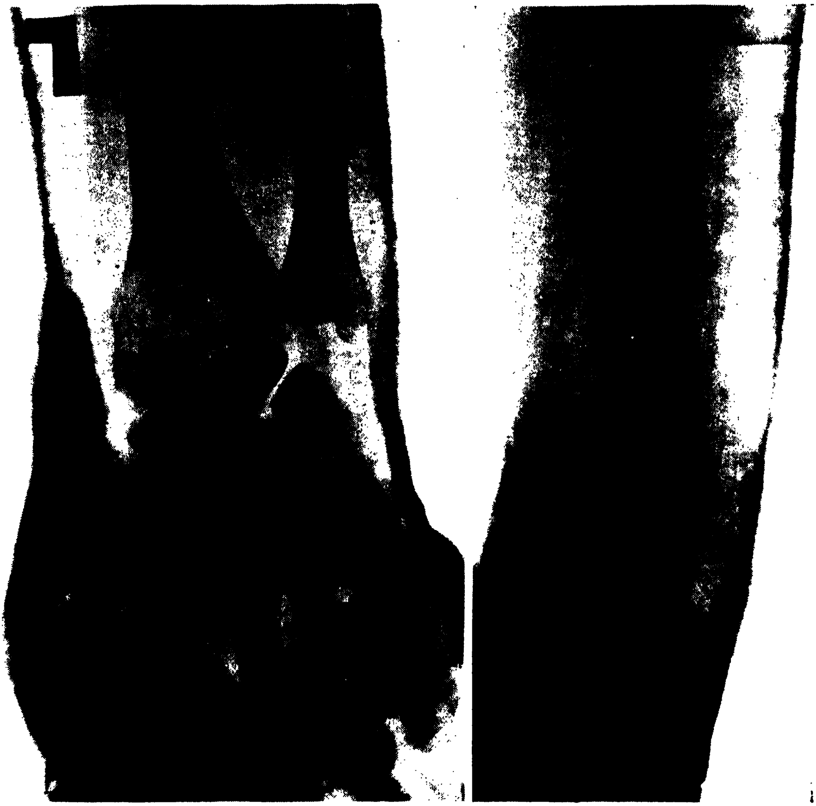

FIG. 77.—POSTERO-ANTERIOR VIEW. FIG. 78.—LATERAL VIEW.

Colles's Fracture. Same subject as Figs. 75 and 76. After reduction and in plaster.

*From photographs lent by the Worthing Hospital.*

*Treatment by Immobilisation in Plaster.* This form of treatment is now much used. Immediately after reduction the wrist is immobilised in plaster.

The plaster extends only to the middle of the palm, though it passes round the thumb. The fingers, thumb and metacarpal joints are left free. The plaster encases the forearm, but is not allowed to impede elbow movement.

The patient is taught to continually exercise the free joints of the arm. The following must be done:—Flex. and ext. and spreading of fingers and thumb. Flex. and ext. of the elbow. In the shoulder:—Flex. and ext. and circumduction, and to obtain abduction and external rotation the patient places his hand on the back of his neck and tries to touch the opposite shoulder. To obtain internal rotation he places his hand behind his back.

Crawling up the wall with the fingers as high as possible is useful.

The arm is not carried in a sling, and the patient is urged to use the hand and fingers as much as possible.

The plaster is removed in 4 to 6 weeks and massage and movements are often given for about two weeks to restore strength and full range of movement in the joints.

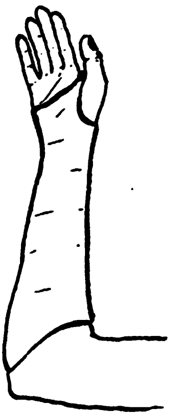

FIG. 79.—PLASTER FOR COLLES'S FRACTURE.

## Treatment of Special Fractures of the Lower Extremity

### FRACTURE OF THE NECK OF THE FEMUR

Fractures of the neck of the femur may be either intra- or extra-capsular. The intra-capsular variety is most frequently seen in women of advanced age. This fact is explained by the atrophic changes which take place in the neck of the femur of elderly people. The accident is due as a rule to some slight stumble or fall, the bone yields and the patient falls to the ground. The line of fracture may be transverse or oblique. Impaction is not usual, and if the patient is healthy there may be bony union, but a loose fibrous union is often the only result. The extra-capsular variety is usually caused by direct violence—*e.g.* a heavy fall upon the hip. It is most usually seen in people of middle age. The line of fracture is along the attachment of the capsule in front, and below it behind. The great trochanter is often involved, and may be comminuted. There is usually impaction. Union of the fragments is more certain in this variety than in the intra-capsular. Eversion is characteristic in both forms of

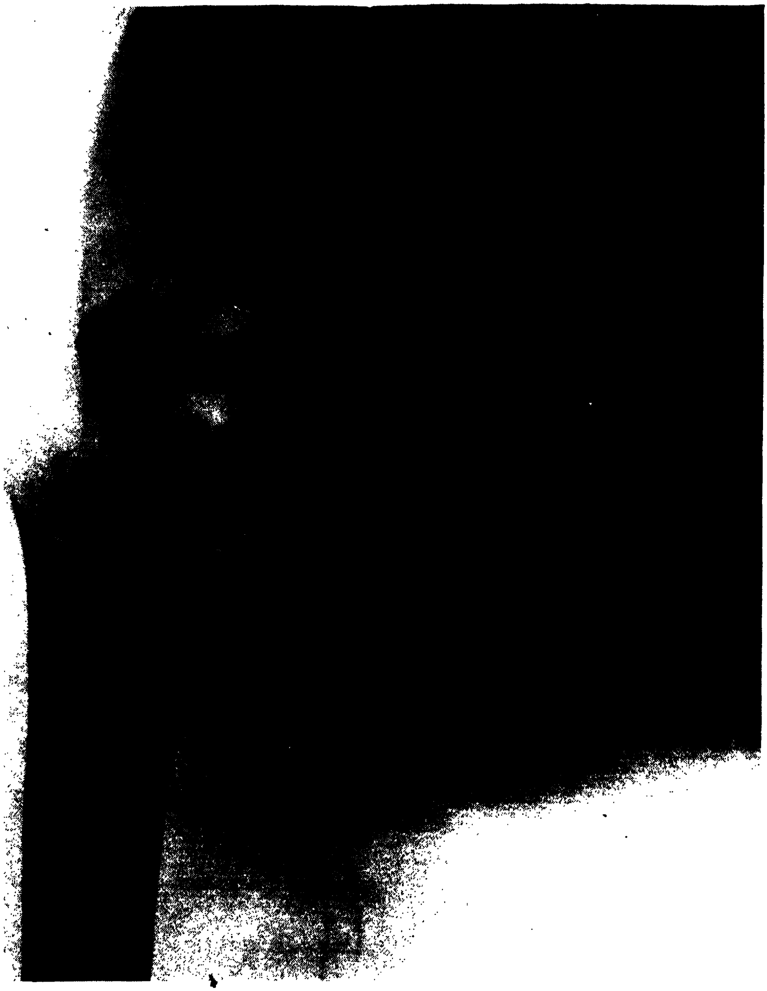

FIG. 80.—INTER-TROCHANTERIC FRACTURE OF THE FEMUR WITH SLIGHT COXA VARA DEFORMITY.

*From a photograph lent by the Worthing Hospital.*

the fracture, and with it the limb lies on its outer side.

*Treatment.* If the patient is young or middle-aged the fracture is set in an abduction splint or a *plaster spica* of the hip is applied. The whole leg is generally enclosed and the plaster worn for at least two months. The patient remains in bed, but should be instructed to move the toes continually, also the ankle, should it be left free.

After the plaster is removed, the patient is probably in bed for another month. During this time massage is given, active movements in all the joints are encouraged, and exercises for re-education in walking are given.

For elderly people the most modern surgical method of treating this condition is by the introduction of a Smith-Petersen pin. This is a three-flanged stainless steel pin which is driven through the fragments from below the great trochanter, and into the head and neck of the bone.

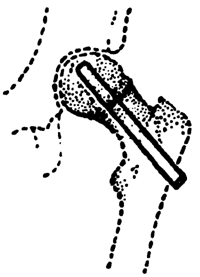

FIG. 81.—THE SMITH PETERSON PIN.

*From "Short Practice of Surgery." Bailey & Love (H. K. Lewis & Co., Ltd.)*

The advantage of the method is that all joints, including the hip, can soon be moved, in fact the mobilisation may begin the day after the operation in the foot and ankle. Movements may also be started in the hip-joint, beginning with very slight flexion and gradually adding others.

Another advantage is that in about three weeks the patient is fitted with an ambulatory splint, he gets up and begins to walk on crutches.

The splint is worn for four months, but during this time exercises are continued and the walking is re-educated.

## FRACTURE OF THE SHAFT OF THE FEMUR

In spite of the great strength of the femur, fracture of the shaft is a common accident. It may occur at any point, and be due to either direct or indirect violence. There is nearly always displacement, and overlapping of the bone ends, causing shortening of the leg.

The limb is placed in a Thomas's splint or immobilised in plaster, or a specially devised apparatus is used. Some form of traction is required, in order to draw the displaced bone into alignment.

Apparatus may be used whereby the fracture is immobilised and traction applied, and yet arrangement is made to allow the patient to actively move his joints, also to lift his pelvis from the bed.

Whatever form of fixation is used, it is maintained for eight weeks, thus allowing time for the bone to consolidate.

During the time the patient is in bed, breathing exercises are important. Instruction must be given and the breathing repeated several times a day. Bed exercises should also be carried out for all parts of the body not immobilised on account of the fracture. The non-injured leg must have attention, preparing for extra work when the patient walks again.

After 4 weeks when callus has become somewhat firm, muscle contractions may begin on the injured limb. The patient learns to tense the muscles individually and together.

Massage of the muscles may be added, and active movements in all joints are gradually done (without weight bearing).

When the patient is allowed to get up, sometimes another plaster is applied for several weeks and crutches are used, or a walking caliper is worn. If possible, massage and movements are continued until strength and full range of movement is restored.

Stiffness of the knee-joint often accompanies this condition, and mobilising exercises must be given.

Later, re-education in walking is necessary.

### FRACTURE OF THE PATELLA

Fracture of the patella is due to direct violence, or to sudden muscular contraction.

" When the knee is semi-flexed, the patella is poised upon the front of the condyles of the femur, resting upon the middle of its articular surface ; in this position any sudden and violent contraction of the Quadriceps, as in attempting to recover one's equilibrium after having slipped, takes the bone at a disadvantage, and may succeed in snapping it." " The signs of this fracture consist of loss of power in the limb, pain, distension of the joint with blood, and separation of the fragments. This displacement is due to unopposed muscular action." " Fibrous union is the usual result, and when this is short and strong it may be quite satisfactory " (*Rose and Carless*).

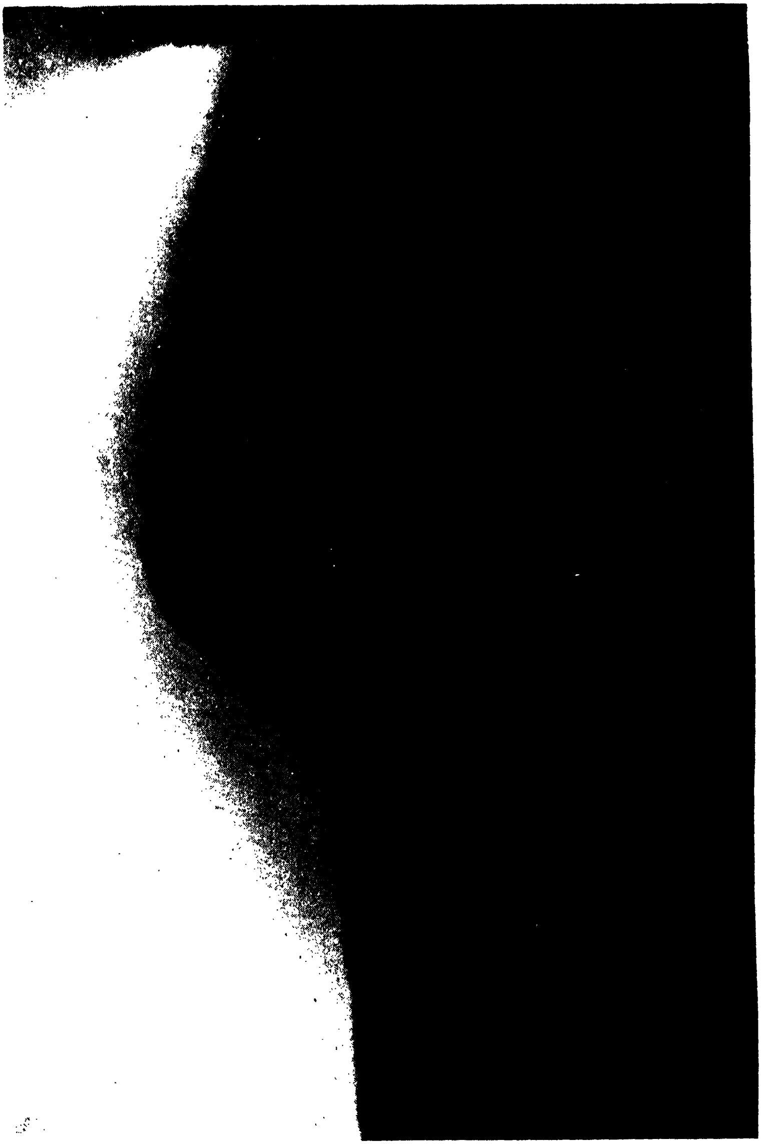

FIG. 82.—TRANSVERSE FRACTURE OF THE PATELLA, SHOWING CONSIDERABLE SEPARATION OF THE FRAGMENTS.

*From a photograph lent by Dr. Stanley Melville.*

The patella is fractured: (*a*) Transversely, and the fragments may be widely separated. (*b*) A stellate fracture may occur, and the bone is sometimes comminuted. (*c*) The fragments may be held together by the Quadriceps tendon, and there is no displacement.

*Treatment.* This will depend upon the type of fracture, also the age and condition of the patient. Owing to the great swelling which usually occurs, the limb is usually placed on a back splint, and kept completely at rest for a few days.

If the patient is a suitable subject an open operation is done.

It has been customary for the fragments of bone to be wired together, but it is now more usual for the surgeon to entirely remove the fractured fragments, and then suture the tendinous expansion. A pressure bandage is afterwards applied.

If open operation is not suitable, massage and movements are probably ordered—beginning a few days after the injury, when swelling begins to subside.

Some surgeons prefer to *immobilise the extended knee in plaster* from groin to ankle. The plaster is so applied that the patient is able to walk about, and is urged to do so.

*Physiotherapy Treatment when no Operation has been done.* The knee is fully extended on a splint, a foot-piece supporting the foot in dorsi-flexion. Sometimes apparatus is applied to hold the bone fragments together.

*Massage* may be given from the first. Much effleurage to reduce swelling and supporting the fracture all the time.

After bandages are re-applied the patient is instructed to move the toes.

During the second week gentle kneading may be added and limited movement in the ankle-joint.

In about fourteen days the patella may be moved from side to side. A small movement is also begun in the knee-joint. The operator fixes the patella and supports under the joint. Then the patient attempts to draw the leg up on the bed, bending both hip and knee.

After three weeks the leg is lifted on to a firm cushion and the treatment is gradually increased. The Quadriceps needs much attention. Petrissage and light hacking may be given and the patient is taught muscle contractions.

After four weeks massage is continued to the whole limb and the knee is flexed over the side of the bed and movement is gradually increased.

Careful leg-swinging is added.

Active exercises are done in the toes and ankle in long-sitting, and later in sitting.

After 5 to 6 weeks the patient begins to walk wearing some form of knee support.

Re-education in walking and a few stronger exercises may be added, *e.g.* :—

Half-lying knee flex. and ext.
Reach gr. st., alternate knee-lifting.
Reach gr. st., heel and toe raising.
Marching in spaces and foot-placing.

*Physiotherapy after Operation.* Early treatment is delayed, but as soon as permission is given the muscles of the thigh, lower leg and foot may be massaged, and active movements encouraged in the toes and ankle. This may begin without removing bandages.

The operation stitches are usually removed in ten days, and treatment may then proceed.

The massage may continue, and muscle contractions of quadriceps, hamstrings, and gluteii are taught. Great care must be taken in the region of the scar though gradually frictions are given around it.

*Movements* in toes, foot and ankle. Knee movements may also begin at this stage. Cautious knee flexion in side lying, and supported in a sling if available. Lying, leg lifting may also be begun.

*After three weeks* the knee may be flexed over the side of the bed, and movement is gradually increased. Weight bearing is also started. With the support of a firm bandage, the patient begins to stand and walk, at first using two sticks.

Re-education exercises are gradually added. Faradism on the muscles is also given.

### POTT'S FRACTURE

A fracture of the lower end of the fibula, three inches above the tip of the malleolus, is known as a Pott's fracture. There is outward and backward displacement of the foot, and rupture of the internal lateral ligament. Sometimes the tip of the internal malleolus is also fractured.

"Fractures in the neighbourhood of the ankle-joint are usually produced by indirect violence, the foot slipping, and leading primarily to a displacement of the ankle, the fracture being a secondary result." "In Pott's fracture sudden abduction of the foot results in severe strain upon the internal lateral ligament, which gives way, or the base of the internal malleolus is torn off. The astragalus is thereby driven against the inner aspect of the external malleolus, and tends to displace that portion of bone outwards. The force is then transferred up the fibula, which bends and breaks at its weakest spot." "The foot is rotated out or abducted, the heel is drawn up, whilst the toes point downwards" (*Rose and Carless*).

After reduction the limb is set on a splint or immobilised in plaster.

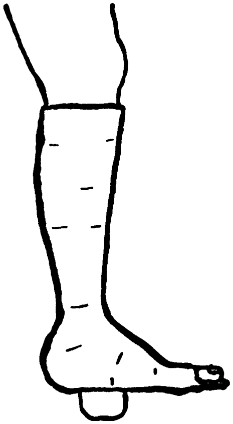

FIG. 83.—WALKING PLASTER FOR POTT'S FRACTURE.

If the former is adopted a back splint with a foot-piece is used. The foot is dorsi-flexed and inverted. The splint does not extend above the line of the tubercle of the tibia. Side splints are also applied and are fixed independently by bandages or straps at the ankle and knee.

Massage may be given from the first. Side splints only are removed. The thigh muscles are massaged, also the knee-joint, and effleurage given where possible to the lower leg.

The patient is taught contractions of Quadriceps and is instructed to move the toes.

*About the fifth day* the bandage fixing the foot-piece may be removed, and effleurage and gentle kneadings given to the foot, also very limited movement to the ankle-joint after the end of a week.

*About the tenth day* the leg is lifted from the splint for treatment and movement in the knee is added.

The massage and movements are gradually progressed, but no lateral movement of the foot must be given for at least two weeks.

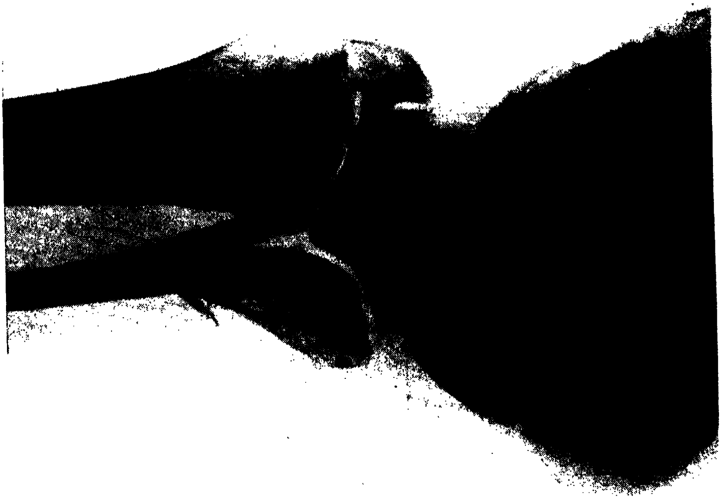

FIG. 84.—ANTERO-POSTERIOR VIEW.

FIG. 85.—LATERAL VIEW.

Pott's Fracture. Before reduction.

*From photographs lent by the Worthing Hospital.*

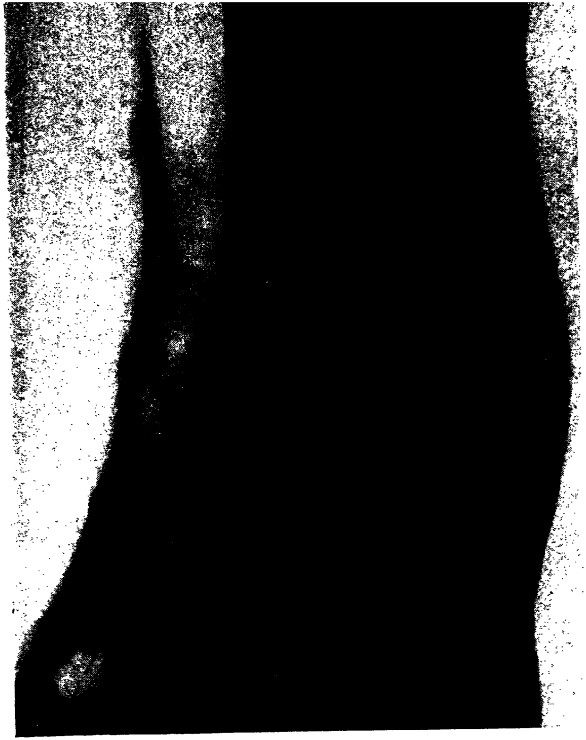

Fig. 86.—Antero-posterior View.

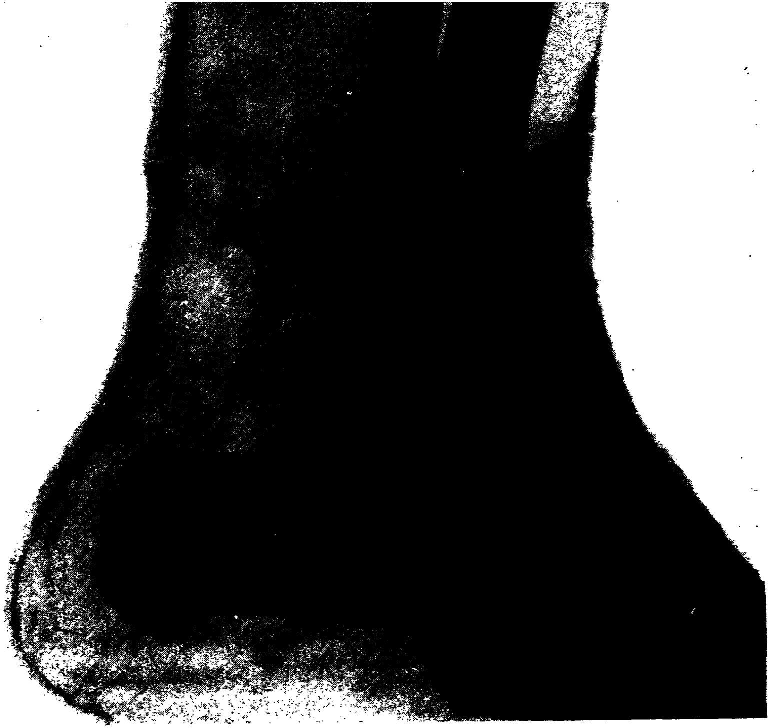

Fig. 87.—Lateral View.

Pott's Fracture. Same subject as Figs. 84 and 85. After reduction and in plaster.

*From photographs lent by the Worthing Hospital.*

*Three weeks after injury* massage is increased. Effleurage and kneading and much friction of the foot and ankle-joint is required.

The range of all movements is increased gradually though eversion must not be taken to its full limit till later.

At this stage the splint is discarded and the patient may be allowed to walk on crutches. In about six weeks he begins to bear weight on the foot.

Exercises in sitting and standing are given and careful re-education in walking is necessary.

*Immobilisation in plaster* is much used at the present time. After reduction the plaster is applied. Sometimes a walking iron may be imbedded in it or a plaster heel is added.

A few days after the injury the patient gets up and is taught to walk in his plaster. As soon as possible he is encouraged to lead as normal a life as he can.

The plaster is worn for 5 to 6 weeks, and sometimes another adjusted for a similar time. When the plaster is discarded the patient is allowed to walk as usual, though a short course of exercises and re-education may be required.

### FRACTURE OF THE TIBIA AND FIBULA

Fracture of the tibia and fibula is a very common accident. One or both bones may be broken. After reduction by the surgeon, this fracture may be set on a back splint with a foot-piece. Side splints are also applied with straps and buckles outside the bandages which fix the back splint. An alternative treatment is by the use of plaster of Paris.

Should the method of splinting be adopted, massage may begin on the second or third day after reduction, first treating the thigh with effleurage and kneading, also giving assisted movements to the toes, which are left free. After one week the side splints are removed and effleurage and kneading given to the lower leg, the limb lying on the back splint. Toe movements are continued, and the patella manipulated. Very limited movement in the ankle-joint is begun, and gradually increased. After two weeks the limb may be lifted from the splint with much care and support.

Massage is continued and assisted active movements given in all joints of the foot and ankle.

The splint is discarded in about four weeks, and the patient begins to walk on crutches. No weight bearing is allowed, but massage and exercises are continued to strengthen the muscles and increase the range of movements in the joints. After 10 to 12 weeks the patient begins to bear weight and his walking must be re-educated.

*Should the plaster method* be used the leg is encased from mid-thigh to the toes.

If there has been severe displacement of the fragments, some form of traction may be required, the apparatus for this being combined with the plaster. The patient must lie in bed for 4 or 5 weeks. As his toes are not included in the plaster, he is instructed to move them frequently.

In some cases *a walking plaster* is applied, and the patient gets about in it, in the way described for a Pott's fracture. After 4 or 5 weeks the plaster is renewed for a similar time, and when finally removed the patient must have exercises to re-educate his walking.

### FRACTURE OF THE BONES OF THE FOOT

Fracture of the tarsal and metatarsal bones may occur when the foot is severely crushed. The result is usually comminution of the bones. Os calcis and astragalus are fractured by falls on to the feet from a height.

*Treatment.* The foot is *immobilised in plaster of Paris,* in which the patient walks on crutches for some weeks. As soon as the plaster is removed, massage and exercises are given to restore mobility and strength.

## Re-education in Walking after Leg Injuries

It is important to train all patients to walk correctly after injuries to the lower extremities. See Re-education exercises, p. 73. Balance walking, p. 129. Flat-foot exercises, p. 258.

### FRACTURE OF THE PELVIS

This is generally caused by a fall, a severe blow, or by crushing. The patient suffers from shock and the pelvic organs may be injured. When this happens the condition is very serious. If a fractured pelvis is suspected, the patient must be moved with great care and carried to hospital without delay. Good nursing and lifting with great caution is very important.

The pelvis may be fractured in a variety of ways, and there may or may not be displacement of the bones. If there is no displacement complete immobilisation is not necessary, but the patient is kept in bed for 2 or 3 weeks, and then when free from pain, he is allowed to get up and move about.

If the injury has been more serious, and displacement has occurred, the patient remains in bed 4 to 8 weeks, and is strapped or fixed with some apparatus.

Massage may be given to accessible parts, also breathing and bed exercises, according to the severity of the injury and apparatus used.

Exercises to arms and feet, and muscle contractions to thighs and lower legs are added.

A canvas sling is sometimes used to support the pelvis, and later suspension and pulley exercises are useful.

When the patient is able to stand and walk again, careful re-education in walking must be taught.

### FRACTURE OF THE SPINAL COLUMN

The spinal column can be fractured in a variety of ways. The bodies of the vertebræ may be crushed. The transverse and spinous processes may be broken. There may at the same time be injuries to soft tissues, including muscles, blood vessels and nerves. There is pain, tenderness and muscle spasm. If the injury is not severe, the patient is kept in bed only for a short time, and is probably " strapped."

*Physiotherapy Treatment.* Radiant heat, massage, breathing and relaxation exercises, and by degrees gentle mobility exercises.

If a vertebral body has been fractured, and the 12th dorsal is the most common, a plaster jacket is applied and worn from 3 to 4 months.

As soon as the plaster is dry, the patient is taught extension exercises for the spine, and these are practised daily. It may be necessary for the jacket to be renewed.

Suggested exercises in jacket.

Breathing and relaxation.
Head extension.
Lying, 1 and 2 leg raising and sinking.
Lying or sitting, free arm exercises.

When the plaster is removed, the exercises may be increased and trunk movements added.

*e.g.* Trunk rolling.
Back raising.
Trunk turning.
General corrective position.
Exercises involving bending the trunk forwards are delayed for 10 to 14 days.

Later the patient may join in games. Some are advised to attend a course of rehabilitation before returning to work.

### FRACTURE OF THE COCCYX

This may be caused by a fall in the sitting position. It results in a painful condition, which continues for some time.

*Treatment.* Rest for several weeks is often necessary. Radiant heat and anodal galvanism give relief.

# CHAPTER XX

DISLOCATIONS: — Traumatic dislocations — Signs — Treatment — Shoulder dislocation—Other injuries to shoulder—Elbow—Hip—Knee — Ankle — Congenital dislocations — SPRAINS — Sprain and rupture of muscles and their tendons—Sacro-sciatic strain—SYNOVITIS—acute—chronic—Teno-synovitis—Bursitis — KNEE-JOINT—Displacement of a semi-lunar cartilage—Stiff joints—Volkmann's ischæmic paralysis and contracture — Myositis ossificans—Tennis elbow.

A DISLOCATION is an abnormal condition occurring in a joint when the articular surfaces of bones are displaced from each other.

A complete dislocation, also called a luxation, is one in which the articular surfaces of the bones are completely separated from one another.

An incomplete or partial dislocation, also called a subluxation, is one in which the surfaces are only partially separated.

Bones may dislocate in any direction, and may be accompanied by fracture. The dislocations may be traumatic or congenital.

## TRAUMATIC DISLOCATIONS

These occur most frequently during adult life. Direct violence applied to or near the joint of a child is more likely to lead to a separated epiphysis than a dislocation, and in old people the bones become more brittle, so fractures more commonly occur. Dislocations are more frequently seen in men than in women, owing to their greater exposure to injury.

*Signs of Dislocations.* (*a*) Pain. (*b*) Swelling and bruising of soft tissues, caused by effusion of synovial fluid into the joint cavity, and extravasation of blood and lymph into the surrounding tissues. (*c*) Deformity of the limb. (*d*) Loss of function.

*Changes.* The joint capsule and other ligaments are stretched and torn. The end of the bone may partially or completely protrude through the capsule. Some or all of the following structures may be involved: Skin, subcutaneous tissues, deep fasciæ, muscles, nerves, arteries, veins, synovial membranes, articular and inter-articular cartilages.

*Treatment.* The first part of the treatment of a dislocation is entirely in the hands of the surgeon. It must be reduced with as little delay as possible, and it is very important that the bone should return to its normal position by the same path by which it left it, in order to prevent fresh lacerations of the capsule and other soft parts. Muscle contraction may cause great difficulty in reduction, but this is overcome if the patient is anæsthetised.

The limb is subsequently kept at rest for some days, to allow the rent in the capsule to heal. Cooling lotions may be applied, and in a few days' time gentle massage and movements begun.

At first effleurage to promote the absorption of effusion and to relax muscular spasm. Then gentle kneading must be added to help the process of healing. Later friction round the joint to prevent adhesions and petrissage of neighbouring muscles to prevent wasting and promote nutrition and circulation.

From the first assisted active movements must be done in the joints distal to the injury. The limb must be well supported throughout. In a few days, when swelling and inflammation have subsided, limited and cautious movements are begun in the injured joint. Small active movements *within the limit of pain.* These are increased in range and strength from day to day.

The physiotherapist should find out in which direction the dislocation has taken place, and apply the movements with great care accordingly.

### DISLOCATION OF THE SHOULDER

This dislocation is more common than any other. It may take place in several directions: (*a*) Downwards—sub-glenoid. (*b*) Forwards—sub-coracoid. (*c*) Backwards—sub-spinous. (*d*) Upwards—sub-acromical (this is very rare).

*Treatment.* After reduction the most modern treatment for this injury is to place a large pad of wool in the axilla, enough to produce 60 per cent. of abduction in the shoulder-joint.

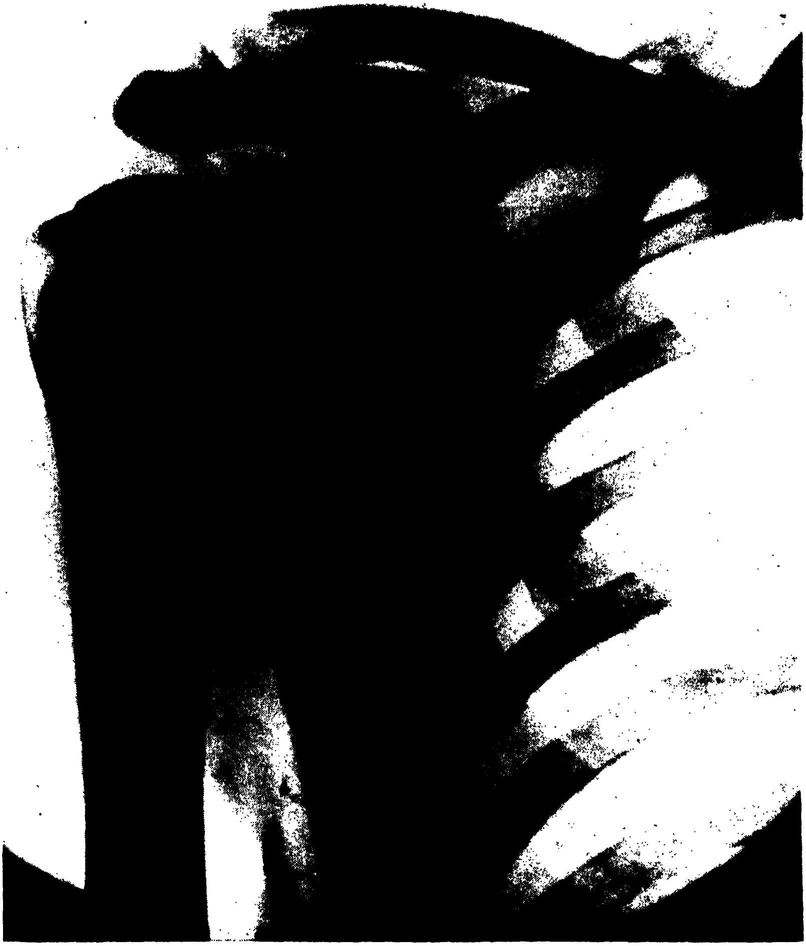

FIG. 88.—NORMAL SHOULDER-GIRDLE.

Antero-posterior view.

*From a photograph lent by the Worthing Hospital.*

The arm rests upon the pad and the forearm is supported in a sling.

Soothing massage may begin at once and should be daily. Effleurage, and in a few days gentle kneading is added.

Active movements in fingers, wrist and elbow are done from the first, and in 3 to 5 days after reduction small assisted movements are begun in the shoulder.

In the early stages these should be done lying, and the first movement attempted is external rotation. The patient is told to turn his arm and look at the palm of his hand. A small amount of abduction is next tried. Later the arm is carried carefully backwards and forwards and by degrees internal rotation adduction and circumduction are added.

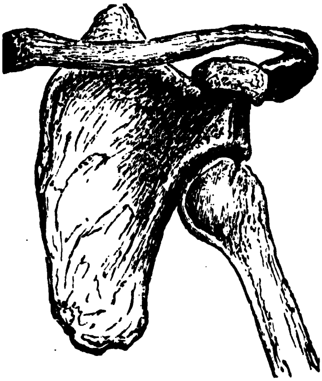

FIG. 89.—SUB-GLENOID DISLOCATION OF SHOULDER.

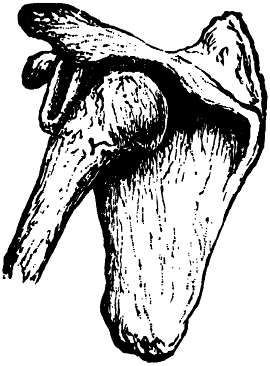

FIG. 90.—SUB-SPINOUS DISLOCATION OF SHOULDER.

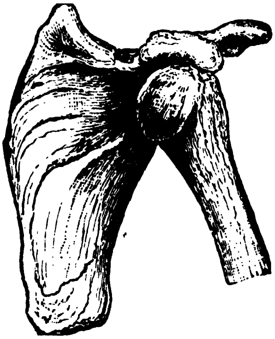

FIG. 91.—SUB-CORACOID DISLOCATION OF SHOULDER.

*By permission, from Rose & Carless's "Manual of Surgery" (Baillière, Tindall & Cox, London).*

The limb must be fully supported by the masseuse or it may be placed in a sling which takes its weight. As progress is made the treatment is increased to stronger massage, and movements are gradually carried to their full range. Internal and external rotation require special attention. The patient practises touching the back of his neck and turning his hand and laying the back of it on the opposite scapula.

Crawling up the wall, gradually abducting the arm and simple double-sided exercises are taught.

### OTHER INJURIES TO SHOULDER

Many instances of injury to the shoulder-joint are seen, although no dislocation has occurred. A wrench may cause

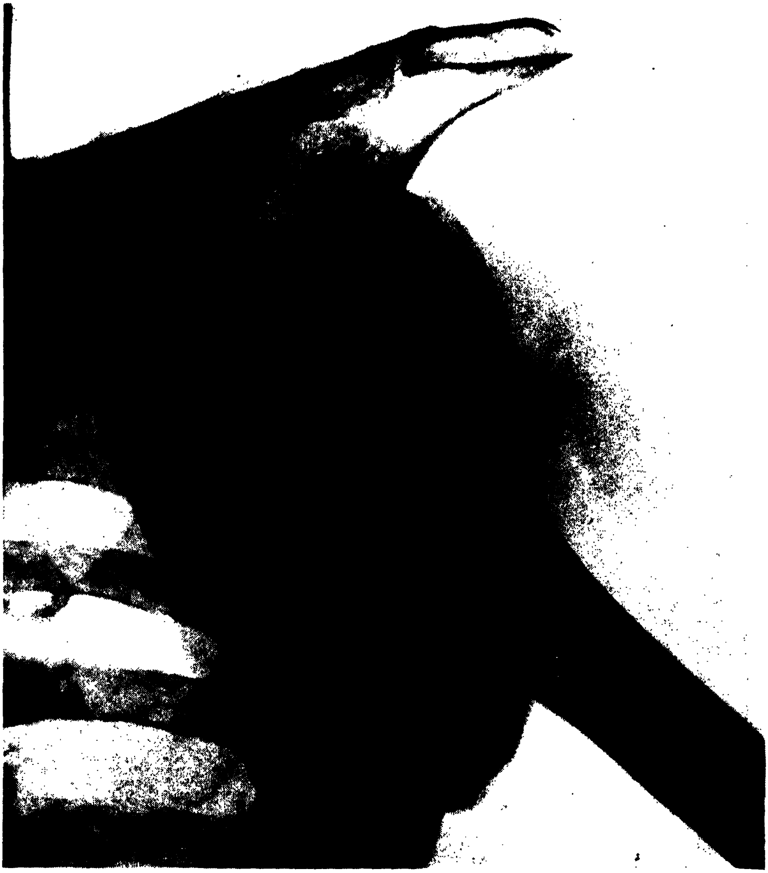

FIG. 92.—DISLOCATION OF SHOULDER-JOINT, AND FRACTURE OF GREAT TUBEROSITY OF HUMERUS.

Antero-posterior view.

*From a photograph lent by the Worthing Hospital.*

effusion into the joint. There is pain, swelling and limitation of movement.

*Treatment.* Rest in a sling for a few days. Heat and massage are applied. The Deltoid needs special attention. Active movements are encouraged as already described, and must be continued until the full range is restored.

In cases of long standing where movement has not returned, the joint is manipulated by the surgeon under an anæsthetic. Soothing massage is given at once, and within twelve hours active movement is encouraged.

## DISLOCATION OF THE ELBOW

This usually consists in the radius and ulna being displaced backwards from the lower end of the humerus. The ulna may alone be displaced. The head of the radius may be displaced forwards, backwards, or downwards. Lateral displacements of the joint are very rare. It is not uncommon for dislocation of the elbow to be accompanied by fracture.

*Treatment.* After reduction the elbow is usually fully flexed and the forearm supinated. It is held in this position by a collar and cuff and the arm is supported in a sling.

*Massage.* None to the joint, though effleurage may be given from the first on the outer aspect of the arm from hand to shoulder. The position of the arm must not be altered during treatment.

*Movements.* From the first small active movements are done in fingers and wrist, also in the shoulder in a small range.

No movement is allowed in the elbow for ten days. There is a fear of causing myosotis ossificans.

After ten days pronation is attempted and extension of the elbow begun, though care must be taken to preserve the flexion obtained by the position.

The limb is often still flexed for two weeks or longer, then gradually brought down. It is carried in a sling and left free at intervals.

If the injury is complicated by a fracture greater caution is required and movement may be deferred for a longer time. By degrees further massage is added and movements in all joints of the limb carried to their full range.

*Note.* When the patient first attempts active movements in the elbow, he should lie on a couch, so that the upper arm is supported. The masseuse gives assistance and the patient aims at touching his throat, clavicle and shoulder with his fingers. In most cases movement is restored in this way and passive stretching of the joint should be avoided.

"*Pulled Elbow.*" This is a common occurrence in children ; it is usually the result of dragging a child along by the hand. The head of the radius is drawn away from the capitellum of the humerus, and a portion of the orbicular ligament is nipped between the articular surfaces. The child holds the arm in semi-flexion and swelling and tenderness are present on the back of the joint.

*Treatment.* After reduction the arm is supported in a sling for a few days and free active movements soon restore the joint.

## DISLOCATION OF THE HIP

As a result of injury, this is not a common condition, but when it occurs it may take place backwards or forwards.

*Backwards Dislocation* may be (*a*) dorsal—when the head of the femur lies on the dorsum of the ilium above and behind the acetabulum ; (*b*) sciatic—the head lies also on the dorsum of the ilium, but lower down.

*Forwards Dislocation* may be (*a*) obturator—the head of the femur lies over the obturator foramen ; (*b*) pubic—the head of the femur lies on the horizontal ramus of the pubis.

After reduction the patient is kept at rest and massage is given. A week later assisted active and passive movements are given.

The treatment is gradually increased in strength and in about a fortnight the patient gets up. He then requires re-educating in walking and free exercises.

## DISLOCATION OF THE KNEE

A dislocated knee is rarely seen alone, but it may occur with injury to the crucial ligaments and fracture of the spine of the tibia. It is a very serious condition and is generally immobilised in full extension, by plaster of Paris or a splint for 6 to 8 weeks.

*Treatment.* Massage may be given to the muscles as soon as it is possible to reach them, also lateral movement of the patella.

No movement will be allowed in the knee for two months or longer, then the joint must be very cautiously mobilised first by flexion over the side of a plinth ; and later by free exercises when weight-bearing is allowed.

Free movements may begin in the ankle as soon as the plaster is removed.

### DISLOCATION OF THE ANKLE

The ankle is rarely dislocated, except when accompanied by fracture. The condition is described as Pott's fracture (p. 193).

### CONGENITAL DISLOCATIONS

The cause of this condition is said to be due to an error in development. The hip is most often affected, but similar conditions are sometimes seen at the shoulder, elbow, and wrist.

Congenital dislocation of the hip is dealt with in the chapter on deformities (see p. 246).

### SPRAINS

A sprain is the result of sudden violence applied directly or indirectly to a joint. There may be tearing of the capsular and other ligaments, involving injury to synovial membrane. There is pain and inflammatory effusion ; also bleeding into the surrounding tissues if the injury is severe. The ankle is the joint most commonly sprained.

Massage aids the recovery of a sprain in a third of the time that it would otherwise take. It may begin immediately and should consist of effleurage above the seat of injury, and then with great care passing over it. This procedure will soothe the nerve endings and reduce the swelling.

Careful and limited movements should also be given to the affected joint, while those distal to the injury should be freely moved. Treatment should be applied daily for from ten to twenty minutes. It must gradually increase in strength and *after two weeks* should include :—

Deep effleurage, friction round the joint, and petrissage of muscles above and below. Passive and active movements. Active flexion and extension may be given as soon as acute inflammation has subsided, but if any lateral ligaments are torn any movement dragging on these injured ligaments should not be given for a week.

Soothing lotions are ordered as a rule for application between massage treatments, but these may be generally discontinued after a week, a firm bandage only being worn between the massage.

## SPRAIN AND RUPTURE OF MUSCLES AND THEIR TENDONS

Muscles and tendons are injured as the result of violent effort or falls.

Muscles may be torn from their periosteal origin. Rupture may occur in the muscular belly or between a muscle and its tendon.

Such ruptures are of common occurrence in men over forty years of age, the muscles most often affected being those inserting into tendo Achillis. It happens to people of sedentary habits who suddenly take some violent exercise. At the moment of the accident the patient experiences a sharp and severe pain, as if he had been struck by a whip. He may also feel and hear a snap. Swelling and bruising will follow together with loss of function.

*Treatment.* Rest for one to two weeks, keeping the affected muscle in a relaxed position.

Massage may then be given. Much effleurage. Friction on and round the seat of injury and petrissage of muscles. Active movements in the joints upon which the affected muscle is working are gradually added.

## SACRO-SCIATIC STRAIN

This condition is caused by lifting heavy weights when in a stooping position, which throws a strain on the Sacro-iliac joint and upon the Gluteii and lower part of Erector spinæ muscle. Other causes may be a faulty attitude, pendulous abdomen, flat feet, and it is sometimes associated with pregnancy.

*Signs and Symptoms.* There is pain in the lower part of the back made worse by stooping, especially if a weight is lifted at the same time. There is pain along the sciatic nerve, and also when lying supine for a long time. If deep pressure is given over the posterior superior iliac spine pain is produced. The patient will also indicate the seat of pain by placing a finger over the same spot. It may be caused by prolonging lying on an operating table under an anæsthetic. If the joint surfaces have been separated the condition is reduced by the surgeon. The legs are forcibly flexed so that the ilia are brought backwards. In most cases there is a backwards dislocation of the upper portion of the sacrum on the ilia, or the sacrum is forced downwards on one side.

After reduction strapping is applied over the lower portion of the back so as to include both the iliac crests.

If occurring in an elderly patient with a pendulous abdomen a surgical belt should be worn.

Massage treatment consists of general massage to the back, giving special attention to Erector spinæ and Gluteus maximus.

Deep friction should also be given into the sacro-iliac joint.

The following exercises may be used :—

Trunk rolling. Trunk side bending and rotation. Sitting, back raising. Crook half-lying, pelvic lifting and rotation. Leg rolling. Leg swinging. High reach grasp st. leg outward carrying and impressing.

## SYNOVITIS

Synovitis is an inflammation limited almost entirely to the synovial membrane of a joint. Other parts are but little affected.

The condition may be due to cold, injury, rheumatism, gout, etc.

*Acute Synovitis.* The usual signs of inflammation are seen. The joint is painful, swollen and hot. It may be red. It is usually held in a position of slight flexion, as this gives the most ease, and it is maintained thus by muscular spasm.

The muscles controlling the joint often waste rapidly.

" Acute synovitis results in hyperæmia of synovial membrane and exudation of plasma. . . . After a time the plasma may coagulate, depositing lymph upon the articular surfaces, whilst serum remains. The lymph thus deposited may either be removed by a natural process of absorption when the inflammation comes to an end, or it may organise and form adhesions. In the later stages the synovial membrane becomes somewhat thickened " (*Rose and Carless*).

*Treatment.* In all severe cases the patient must be put to bed and the limb elevated. The limb often must be kept at rest on a splint. Soothing lotions, ice-bags, etc., are applied to reduce the inflammation. During this acute stage the patient will sometimes have a high temperature, and if this is the case massage is contra-indicated. When the temperature has become normal, and pain subsided somewhat, the following may be given :—

*Massage.* To begin with, the limb is not taken from the splint, but bandages are removed. Effleurage only is given at first beginning above the joint and gradually encroaching upon it. This is done twice daily for from 10 to 15 minutes. As the symptoms subside the treatment is increased, deeper effleurage, gentle friction, and it is important to petrissage the muscles above and below the joint as soon as possible.

*Movements.* Muscle contractions must be taught. Active assisted movements should be done in the distal joints, and when swelling has subsided they are begun in the affected joint. These are gradually increased and easy exercises are eventually given to restore strength and mobility.

## CHRONIC SYNOVITIS

The synovial membrane becomes thick and infiltrated. There is stiffness and weakness in the joint. Sometimes pain on movement. Swelling may still be present, which is often increased by standing and walking. Creaking sounds may be heard.

Sometimes synovial fringes become hypertrophied, and loose ends may be caught in and nipped between the bone.

*Treatment.* Deep massage over the joint. Much friction and tapotement. Deep petrissage of the muscles acting on the joint. Passive and active movements. Time, twenty to thirty minutes daily.

## TENO-SYNOVITIS

" The synovial membranes which line the sheaths of tendons may become inflamed as the result of injury or infection.

" Acute teno-synovitis often follows sprains and strains and is most commonly seen with the extensor muscles of the thumb. A puffy swelling in the course of the tendons is produced, painful on movement and perhaps tender to the touch, giving a characteristic fine crepitus whenever the parts are moved" (*Rose and Carless*).

*Treatment.* The limb is immobilised for a few days and fomentations applied. When the acute symptoms have disappeared massage may be given: Effleurage, friction and assisted active movements.

## BURSÆ AND BURSITIS

A bursa is a small sac of synovial membrane of variable size, containing serous fluids. Many bursæ are normally present in the body, between surfaces which move upon each other, as between tendon and bone, or between a projecting surface of bone and the skin. Their use is to prevent friction, and to enable structures to glide freely upon each other. The most important bursæ are situated:—Between the Deltoid muscle and the capsule of the shoulder-joint; between the olecranon process and the skin; between the big flexor muscles of the hip and the capsule of the joint, and a large one which separates the Gluteus maximus muscle from the trochanter of the femur.

There are numerous bursæ in the neighbourhood of the knee-joint, the chief being (*a*) that over the patella, (*b*) between the ligamentum patellæ and the tibia, (*c*) in the popliteal space between the semi-membranosus muscle and the inner head of gastrocnemius.

New bursæ sometimes develop as the result of continued pressure. This may happen as the result of a deformity, *e.g.* in talipes equino varus a bursa forms over the cuboid; a tailor may develop a bursa over his external malleolus, and a porter carrying heavy weights on his back may have one over the vertebral prominence.

Bursitis is inflammation of one of these serous sacs. It is usually the result of injury. In the acute stage there are the usual signs of inflammation, and the swelling and redness extend a variable distance above and below the inflamed bursa. In the chronic stage the fluid accumulates and distends the bursa. The neighbouring joint feels weak, but there is not necessarily pain and tenderness.

"Housemaid's knee" is the name commonly given to an inflammation of the pre-patella bursa. The affection may be acute or chronic, the swelling being central in front of the patella. If the bursa beneath the ligamentum patellæ is attacked, a fluctuating swelling is seen and felt on each side of the tendon, specially when the knee is extended.

*Treatment.* As for synovitis.

In one form of bursitis the walls of the bursa become thickened, and a hard fibroid tumour is formed. Surgical treatment is generally necessary for this. Massage and movements may be ordered later to restore mobility to the knee-joint. Enlargement of the bursa over the olecranon process is known as " miner's or student's elbow."

## THE KNEE-JOINT

The knee is the largest and most complicated joint in the body. On account of its exposed position and the continual strain thrown upon it, the joint is liable to injury in a variety of ways.

It is assumed that the student has knowledge of the structure and mechanism of the joint, but the following points are of great importance :—

(*a*) The position of the normal synovial membrane, which is more extensive than in any other joint.

(*b*) The structure, position and attachments of the semilunar cartilages and the crucial ligaments.

(*c*) The normal joint movements, including the fact that in the extended position no lateral movement is possible, but when flexed some lateral and rotatory movement may take place.

(*d*) The ilio-tibial band is important in helping to maintain the stability of the knee-joint. At its lower end it is in connection with the capsule of the knee, exerting a traction upon it, and at its upper end it receives a large portion of the Gluteus maximus and all the tensor fasciæ femoris. Weakness of these muscles, therefore, will indirectly cause a weakened knee-joint.

Synovitis of the knee-joint is common. It may occur alone, or be one symptom of a serious condition, such as fracture near or dislocation of the joint. It may also be the result of some bacterial infection.

" The knee-joint when distended with fluid presents a rounded outline, in which all the normal hollows, especially those on either side of the patella, have disappeared. There is also a swelling corresponding to the sub-crureal pouch, more marked on the inner than the outer side of lig. patellæ below, or by alternate pressure on either side of the rectus tendon. When effusion is large in amount, the patella is felt to float, and on pressing it sharply backwards it can be made to tap against the intercondyloid notch of the femur." (*Rose and Carless.*)

## DISPLACEMENT OF A SEMILUNAR CARTILAGE

This condition is often met with as a result of a sprain or strain, the injury usually taking place when the knee is flexed, so that some rotatory movement of the joint is possible. It is a common accident to football, tennis, and hockey players.

"The internal cartilage is much more frequently affected than the external, and the character and extension of the lesion varies very much in different cases. Not infrequently its anterior tibial attachment is torn through, thereby permitting considerable lateral mobility. Its peripheral connections with the capsule and internal lateral ligament may also be ruptured, whilst sometimes a portion is more or less detached from its free border, and in other cases the cartilage has been broken across a little behind its centre. It is obvious that when once its connections have been loosened it can be displaced readily, and may pass into the intercondyloid notch, or may slip out from the tibia and femur, or may even be doubled over. It subsequently becomes inflamed and swollen, and unless properly treated the displacement is likely to be repeated" (*Rose and Carless*).

The loosened cartilage is usually displaced inwards, and a slight deficiency may be present above the edge of the tibia on the affected side.

*Symptoms.* 1. Severe pain, with or without the sensation that something has given way. 2. Locking of the joint in a position of flexion, with inability to extend. This condition may continue for minutes, hours, or days. It may spontaneously return to its normal position with a snap, and so again allow movement. It may require reduction. 3. Tenderness along the line of the cartilage. 4. Synovitis usually follows.

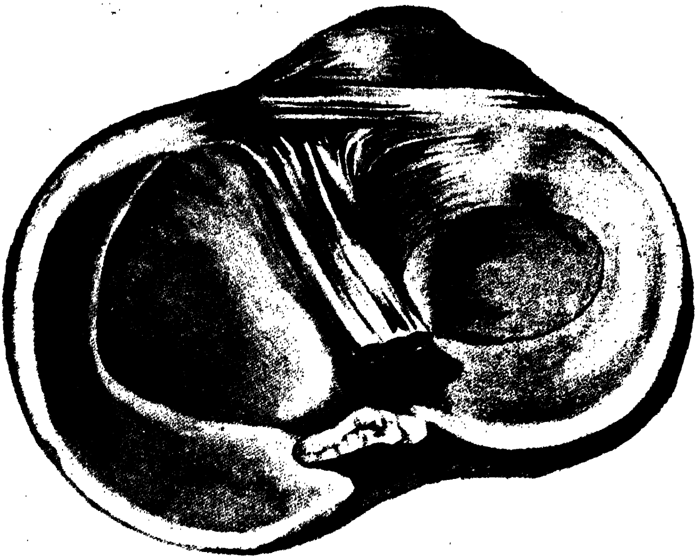

FIG. 93.—UPPER SURFACE OF THE RIGHT TIBIA, SHOWING THE SEMILUNAR CARTILAGES AND THEIR ATTACHMENTS.

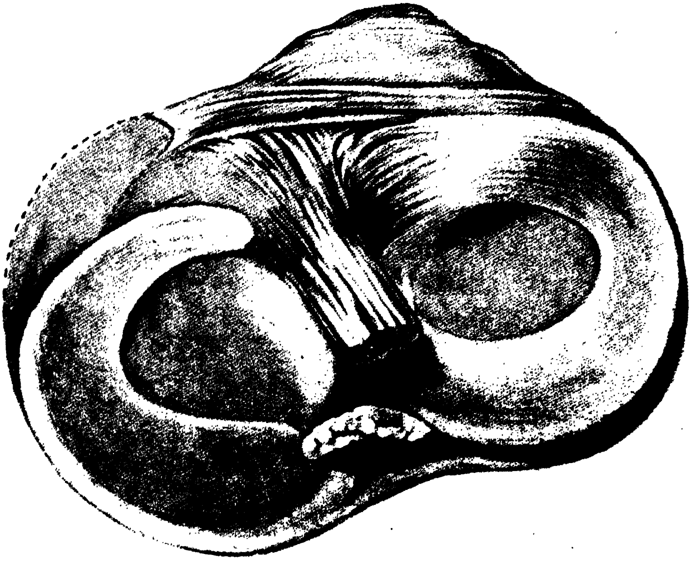

FIG. 94.—DETACHMENT OF THE ANTERIOR HORN OF THE INTERNAL SEMILUNAR CARTILAGE.

*From "Manipulative Surgery," by A. S. Blundell-Bankart, F.R.C.S., by permission of the Author and Publisher, Messrs. Constable & Co. Ltd.*

*Treatment.* If the cartilage requires replacing, the manipulation is performed only by a surgeon. Subsequently the limb is kept at rest upon a back splint, and cooling lotions applied, until the inflammation subsides.

It is usual after a recurrence of the condition for the surgeon to operate and remove the injured cartilage.

*If no operation is performed* massage in the early stages is useful to relieve pain and reduce swelling. Later it strengthens the muscles acting on the joint, and by improving their tone and general condition, an over-stretching of the capsule and other ligaments is prevented. It is impossible to lay down a definite time for beginning massage. If the skin has become sodden by lotions, massage is delayed. If this is not the case, effleurage may be given between applications of lotion, as soon as the inflammation has subsided somewhat, say twenty-four or forty-eight hours after the injury.

*Massage and Movements.* Effleurage of the whole limb. First above the knee, then passing lightly over it, and after to the lower leg and foot. If the limb lies upon a back splint, this should not be disturbed for massage, only the bandages removed.

*In three to six days,* according to the severity of the case, gentle kneading and frictions round the knee may be added, and kneading of all the muscles, above and below the joint. *In six to eight days,* add very careful assisted movements of the knee-joint. At first this may be done in the same way as for a recently fractured patella. The patella must be manipulated. The strength of the massage must gradually increase.

*If an operation is performed* massage and movements are begun the next day. The patient is in bed and the knee is supported by a compression bandage with layers of wool. This is not removed, but massage is given to the thigh, lower leg and foot. Muscle contractions must be practised, and it is an advantage if the patient has learnt to do the contractions before the operation. They must be practised many times a day while the patient is still in bed, as well as active movements in the toes and ankle-joints.

After three days the leg is flexed over the side of the bed and slight assisted active movement is done. On the fourth or fifth day the patient may sit on a chair, flex his knee a little further, and press his foot on to the floor. He may also attempt standing and walk once round his bed.

About the fourth or fifth day the compression bandage may be removed during treatment—but must be replaced.

On the tenth day the stitches are removed and all treatment is gradually increased, viz. :—

Deep effleurage and muscle kneading, friction round the knee, though care is required in the neighbourhood of the scar. Patella manipulations.

All active movements in the foot and ankle, and the knee flexion and extension is gradually increased till it reaches its full range.

After two weeks exercises are added, *e.g.* :—

Forward lying, double and alternate knee flexion and extension.
Sitting, leg swinging.
Sitting, leg flexion and extension plus strong resistance.
Sitting and standing, heel and toe raising.
Reach gr. st., alternate knee-lifting.
Reach gr. st., heel raising and knee-bending.
Marching, with knee-lifting.
Skipping.

## STIFF JOINTS

Stiff joints frequently occur as the result of fractures, dislocations, sepsis, rheumatism, and gout. Each of these conditions is dealt with separately in this book and needs careful study by the physiotherapist. Many stiff joints are caused by adhesions, due to exudations into the tissues, and matting of the parts surrounding the joint. Friction and passive movements are efficacious in the treatment of such conditions. Often they cannot be administered without some degree of pain to the patient, but the friction should begin gently, and gradually increase in strength, and passive movements should be done in small excursions and gradually be made larger. If these principles are carried out, less pain is caused than when friction is suddenly deep and the movements forced. A stiff joint should be coaxed back to its normal state rather than forced. Active movements should be added as soon as possible. These are important because, as well as exercising the patient's brain and improving the nutrition of the muscles, they have a very beneficial effect upon the tendons. In the case of stiff fingers during voluntary action the tendons are made to move within their sheaths, whereas during passive movements tendon and sheath move as one. Soothing effleurage, petrissage of the muscles, and strong tapotement are also necessary for these cases.

Sometimes the surgeon advises manipulations under an anæsthetic. This he does himself. The joint is tender and sore after, but the massage may be resumed the following day, to soothe the pain and prevent adhesions re-forming.

Massage is frequently ordered after septic conditions. The neighbouring joints are stiff, and the tissues hardened. There are frequently scars of injuries, also of incisions which have been made by the surgeon during treatment in the earlier stages. Such cases require persistent massage, the performance of which can only be learnt by practice. Again friction and passive movements will be found the most suitable.

Massage is of no avail when joints become ankylosed as the result of bony changes.

### VOLKMANN'S ISCHÆMIC PARALYSIS AND CONTRACTURE

Volkmann's ischæmic contracture is a serious condition seen usually in the forearm and hand, as a result of over-constriction of the limb. It generally occurs in children after some injury, *e.g.* a fracture when splints and bandages have been applied too tightly.

Ischæmia means a deficiency of blood, and Volkmann considered the condition to be due to diminished arterial supply and consequent lack of oxygen. There is also venous stasis causing exudation into and between the muscle fibres. These changes result in a breaking down of the muscle protoplasm and paralysis due to pressure on the nerves, the part becoming rapidly contracted. The blood supply is not completely cut off, else gangrene would ensue, but the condition is somewhat like that of rigor mortis.

The signs of ischæmic contracture come on rapidly when bandages are too tightly applied, or the elbow fixed in acute flexion.

In the early stages there is pallor and coldness of the hand and impairment of the radial pulse. Later there is pain, the parts swell and become discoloured, and in about twenty-four hours the hand assumes the claw-shape. Generally the flexor muscles on the ulnar side are affected the most. Eventually the elbow is flexed, the forearm pronated, the wrist flexed, and the fingers clawed.

*Treatment.* This should be preventive. In all injuries, bandages, dressings, etc., must be so applied that they do not over-constrict the part. If the signs described above appear, bandages should be removed, the injury be carefully fixed, and effleurage and passive movements applied. If treatment is necessary later, the part should be bathed in hot water twice daily, and then carefully massaged with effleurage, frictions, and passive movements. Special attention must be paid to the contractions.

Should such manipulations fail, the surgeon operates to free the arteries which have been trapped and injured.

Sir Robert Jones' method of gradually stretching and splinting has been used with success in mild cases of this condition.

## MYOSITIS OSSIFICANS

This is a condition in which ossification in muscle tissue takes place.

It is the result of (*a*) inflammation or chronic irritation in muscle or tendon as seen near the insertion of adductor longus in those accustomed to riding—" Rider's bone " ; (*b*) injury. From this cause it sometimes occurs in the Brachialis anticus muscle following a fracture of the lower third of the humerus or a dislocated elbow. A hard mass may be felt and the condition may be verified by X-ray.

Limitation of movement results. There is aching and fatigue from pressure on the nerves in the neighbourhood of the mass.

*Treatment.* Massage and movements are not indicated, in fact the condition when occurring in the arm may be caused or aggravated by ill-advised forced movements performed to prevent stiffness of the joint. Surgical treatment is sometimes necessary.

## TENNIS ELBOW

This is a condition caused by overstrain on the muscles near the elbow-joint. It was first described as a " tennis-player's disability," but may be caused by other games or strenuous occupations, which entail repeated forcible movements, especially extension of the wrist.

A faulty technique in the game or occupation may cause the trouble.

There are two types—*muscular* and *tendinous*, depending on where the strain has occurred in the extensor muscles.

*Muscular type.* As the result of some forcible movement there is sudden pain near the elbow on the outer side of the forearm, and there may be swelling and tenderness. This type is similar to muscular strains which may occur anywhere in the body.

*Tendinous type* may be sub-acute, when there is pain down the back of the forearm, extending to the ring and middle fingers, especially when the patient grips something with a straight arm, or pain and aching gradually comes on and continues on the outer side of the elbow.

This tendinous type is usually seen in middle-aged people, and it is an injury which has no parallel in other parts of the body.

" The lesion is a tear between the common extensor tendon and the periosteum of the lateral humeral condyle." (Cyriax.)

If the wrist is extended there is tenderness at the elbow, and a tear is probably indicated at the origin of the extensor carpi radialis brevis muscle.

*Treatment. For the Muscular Type.* This is the same as for any other sprain, viz., rest from the occupation which caused the injury. Heat, massage of the elbow-joint, forearm and hand. Active movements.

*For the Tendinous Type.* Immobilisation in plaster may be ordered with the wrist placed in extension. This method insures that the two edges of the tear are held in apposition.

*Later.* Heat and active movements are employed. Ionisation is often used, and good results are obtained from the application of the Kroymayer lamp. Sometimes a surgical manipulation is necessary, or the surgeon performs a tenotomy on the affected tendon.

# CHAPTER XXI

ORTHOPÆDICS OR DEFORMITIES :—Wry-neck or Torticollis—Congenital—Acquired—Spasmodic—Cervical rib—The normal spine—Curvature of the spine—Scoliosis—Kyphosis—Lordosis—Angular curvature—*Deformities of the upper extremity*—Sprengel's shoulder—Congenital contraction of the fingers—Dupuytren's contracture—*Deformities of the lower extremity*—Congenital dislocation of hip-joint—Coxa vàra—Knock knees or Genu valgum—Bow legs or Genu varum—The foot—Flat foot—Talipes or club foot—Hallux Valgus.

## ORTHOPÆDICS

ORTHOPÆDICS is a term universally used. It embraces all conditions dealing with deformities.

The word " orthopædia " dates from a book written in 1741 by Nicholas Andry of the University of Paris.

Andry took two Greek words, " orthos," straight, and " pais," a child. Later on, however, another Greek word was introduced. " Paideno," to educate, and according to this the word means to " educate straight " (*Shand*).

Surgery is required in many cases, but post-operative treatment is also essential and calls for skilled work from the physiotherapist and orthopædic nurse.

The necessity of prevention and correction of deformity has always been emphasised, and there are some conditions which can be corrected during growth and development by manipulations, exercises and massage.

## WRY-NECK OR TORTICOLLIS

" TORTICOLLIS is a deformity, either congenital or acquired, characterised by lateral inclination of the head to the shoulder, with torsion of the neck and deviation of the face " (*Tubby*). The sterno-mastoid muscle is contracted on one side and stretched on the other. Sometimes other neck muscles are involved, *viz.* trapezius, splenius, and the scaleni.

*Congenital Torticollis.* This condition arises from faulty development of the muscles before birth, or from contraction due to injury during labour.

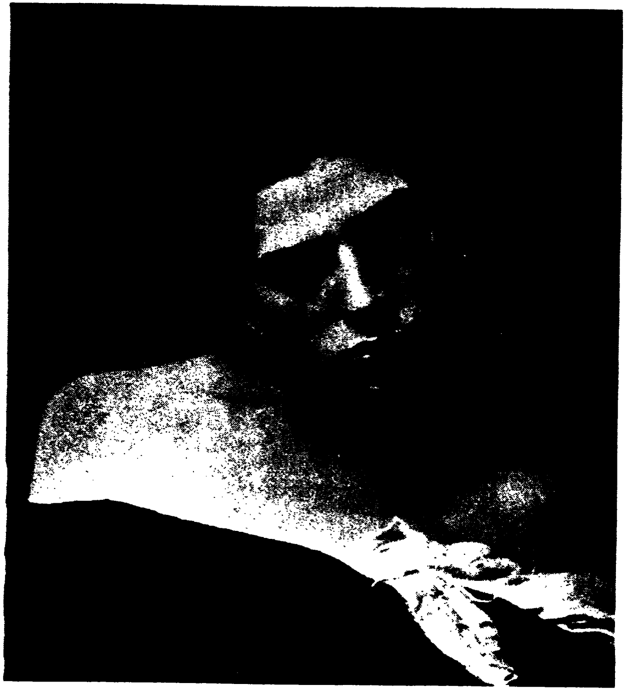

Fig. 95.—Congenital Torticollis before Surgical Treatment.

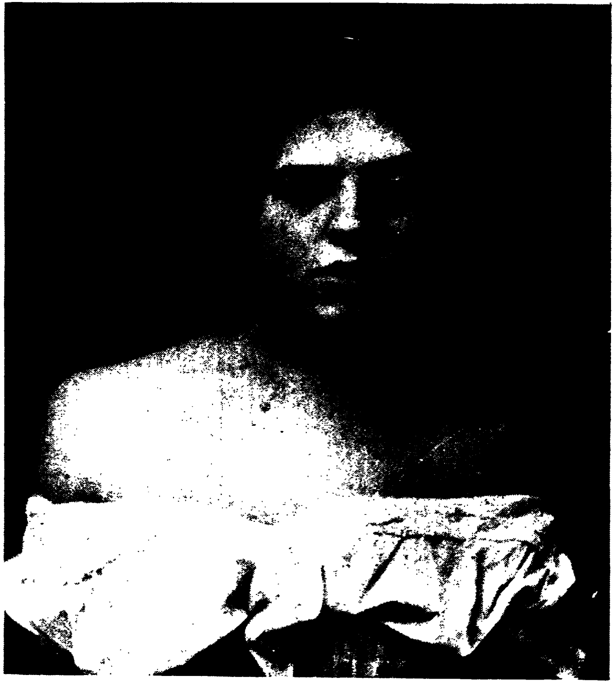

Fig. 96.—The Same Patient as Fig. 95 after Surgical Treatment.

*From photographs lent by Mr. Blundell-Bankart.*

*Signs.* The head is drawn down to one side, the face is rotated to the opposite side of the contraction, and the chin raised. In some cases the face on the side of the contraction is smaller and less developed. The sterno-mastoid on the opposite side of the contraction is stretched and weak, and hardened swellings may sometimes be felt in it. In cases of long standing, cervical curvature may appear, owing to the fixed abnormal position. The contracted muscle is often replaced by fibrous tissue, which has no elasticity. The tissue is sometimes found to contain a hardened blood-clot (hæmatoma), but this condition does not seem to bear any relation to the contraction.

*Treatment of Congenital Torticollis.* If the condition is detected during infancy, movements may be given to stretch the contraction, and correct the deformity.

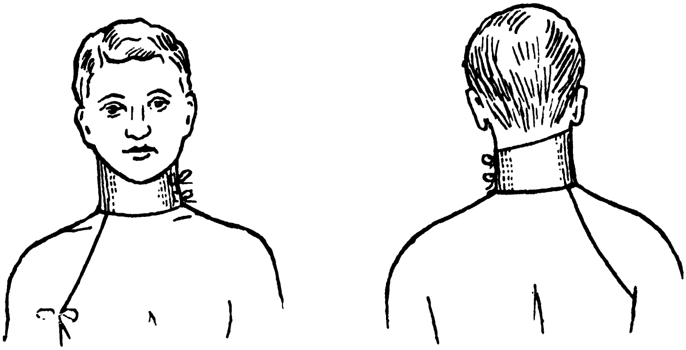

FIG. 97.—PADDED CARDBOARD COLLAR. TO BE WORN AFTER OPERATION FOR TORTICOLLIS.

The child may lie on the mother's knee, the operator sitting behind the child. She grasps the head, stretches the neck and bends the head away from the contraction and rotates the face towards it.

The movements should be done twice daily 6 to 12 times, and the mother be instructed to correct the child's position as much as possible when lying in bed. Later the movements are done by placing the child on a table, and with a second operator fixing the shoulders.

Massage in the early stages is not possible, as the child cries and stiffens his muscles. The above movements, however, must be carried out in spite of crying, and they occupy only a few minutes. At a later stage the child may be attracted by toys, etc., to turn his head and so correct the position.

In older children, 5 to 10 years, when the contraction is uncorrected and more severe, surgical treatment is necessary. A tenotomy is done upon both the sternal and clavicular attachments of the contracted muscle. The muscle is stretched and the position of the head corrected.

Correction is continued the day after operation, the patient lying flat in bed. The head is strongly bent away from the contracted side and the face rotated towards the contraction 2 to 4 times. The patient is up in a few days, and full treatment is gradually given.

At this stage a collar is made of cardboard. It is covered and well-padded with lint. The collar is cut so that it is higher on the side of the contracted muscle. It is tied on with tapes at the side. Another pair of tapes pass from the lower border of the collar on the high side, front and back, and are tied in the axilla.

The collar should be worn day and night for some weeks.

*Full Treatment.* Massage of muscles on back of neck. Effleurage, kneading, petrissage, frictions, hacking. (A detailed account of suitable positions and manipulations is given on p. 37.)

Massage of sterno-mastoid muscles. The patient sits upright, the masseuse supports the head. For the stretched muscle :—Effleurage, petrissage, friction, hacking. For the contracted muscle :—Effleurage, friction, stretching the muscle during the manipulations. Effleurage with both hands on the front of the neck.

*Movements.* Position of patient: (*a*) Lying, the head over the end of the plinth, and supported by the physiotherapist. (*b*) Sitting, the hands firmly grasping a support to fix the shoulders.

Head rolling in both directions, 10 to 20 times. (See p. 99).

Active head bending backwards, concentrically and eccentrically in the inner range. 5 to 10 times. (See p. 135).

Active head side flexion, away from the contracted muscle, concentrically and eccentrically in the inner range. 5 to 10 times.

Active head side turning, towards the side of the contracted muscle, concentrically and eccentrically in the inner range. 5 to 10 times.

The two last may be given as a combined movement.

At the end of each movement the patient should try to hold his head in the correct position without support.

*Head suspension.* This can only be done with an appliance made for the purpose. A hook must be securely fixed to a beam in the ceiling, and the apparatus suspended from it (p. 241).

Instead of the collar described above, an elastic appliance is sometimes worn, to correct the position of the head.

*Acquired Torticollis.* "This may be a mere passing condition due to muscular rheumatism brought on by exposure to cold, and under the name of stiff neck is familiar to everybody" (*Poore*).

The following conditions may cause the head to be held in an abnormal position resembling torticollis: (*a*) Cervical caries of spine; (*b*) infantile paralysis; (*e*) abscess in the glands of the neck. In the latter case, the head is drawn down to the same side as the abscess.

*Treatment.* A temporary condition of torticollis, due to muscular rheumatism, may be quickly relieved and cured by heat and massage. (See treatment of "Rheumatism," p. 290.).

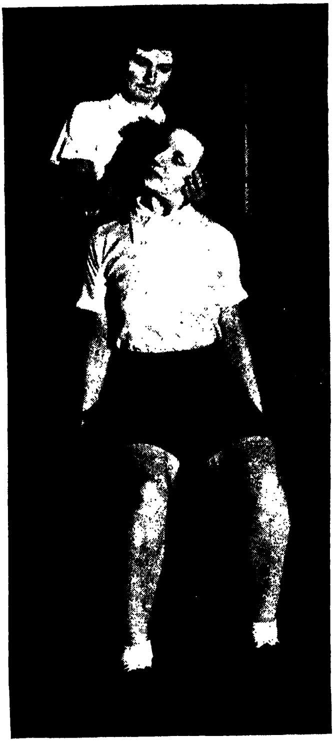

FIG. 98.—HOLDING FOR COMBINED HEAD SIDE TURNING AND BENDING.

*Spasmodic Torticollis.* This is a serious variety, brought about by an irritable condition of the spinal accessory nerve. There is intermittent spasm in the muscles on one side of the neck, which causes the head to be jerked in the opposite direction.

*Treatment.* Massage, if ordered, must be of a soothing nature. Effleurage, vibrations, gentle kneading, and friction.

Head and neck movements may be helpful when given freely, the patient obeying the physiotherapist's commands. Later they should be practised before a looking-glass.

Hysteria is sometimes the cause of torticollis. In this form massage and movements may be helpful, when combined with suggestive treatment.

## Cervical Rib

This occurs when the anterior root of the transverse process of the seventh cervical vertebra exists as a separate bone. A similar growth sometimes occurs from the sixth cervical vertebra.

In early life the rib is composed of cartilage, but later it becomes ossified. It passes down behind the nerves towards the first rib. In many cases it causes no inconvenience, but it may increase in size, and press upon the roots of the brachial plexus, or push forward the sub-clavian vessels, giving rise to nervous or vascular disturbances. There may be weakness, or loss of power of the arm, neuralgia or neuritis. Such pressure symptoms sometimes call for surgical treatment, when the rib is removed.

*Treatment by Massage.* This may be ordered if operation is undesirable, or after it has taken place. In either case the whole arm and shoulder should be treated with effleurage, muscle kneading, hacking, and clapping, passive and active movements. If neuralgia or neuritis is present, nerve treatment must be given. Vibrations with the whole hand over the brachial plexus, and down the arm, also running vibrations on the affected nerves and much effleurage. If the soothing treatment is required tapotement is omitted.

## The Normal Spine

"The spinal column is a flexible structure formed of separate pieces (the vertebræ), which are severally united by discs of fibro-cartilage, bound together by numerous and strong ligaments, and surrounded and acted upon by powerful muscles" (*Brodhurst*).

The spinal column has many important functions. It supports the head, and protects the spinal cord. It supports the ribs, and together with them forms the thorax. It supports certain organs, which may be said to hang upon the spine. Owing to its structure, it acts like a spiral spring, and so prevents shocks to the brain and spinal cord.

The column can bend in all directions, *i.e.* forwards, backwards and sideways, and can also rotate or twist upon itself.

The question of postural activity of muscles and the erect posture of the body has already been discussed in Chapter VI, but both are of great importance here, and should be fully considered when the spine and its functions are studied (p. 60).

" The spine in the fœtus is bent forwards, its curve being moulded to the walls of the uterus. The head is bent upon the breast. In the infant the spine remains almost straight while in the horizontal position. Only the sacrum is slightly curved " (*Brodhurst*).

A healthy baby begins to sit up at from seven to nine months old. He sits with his legs outstretched, and his back remains rounded and the head bent forwards. By degrees, as the postural activity of his muscles develop, he is able to lift his head and so look straight in front of him.

Later he assumes the standing position, learns balance, and begins to walk usually at from twelve to eighteen months old. These functions then become habitual. They are due as already shown (p. 60) to the development of the postural reflex.

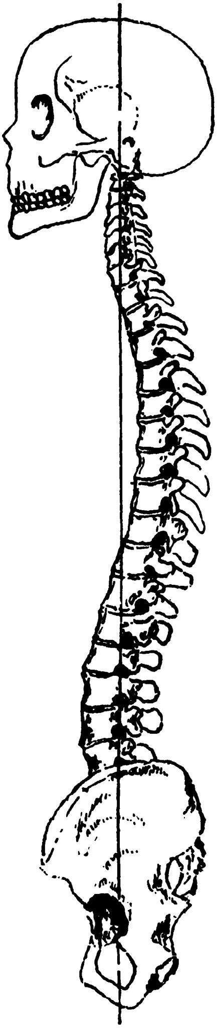

FIG. 99. — LATERAL VIEW OF NORMAL SPINE SHOWING ANTERIOR AND POSTERIOR CURVES.

*After Brodhurst.*

In the adult normal spine there are curves in the antero-posterior direction. These have developed slowly from the time walking is established, but there are no fixed curves before seven years of age.

The spine bends forwards in the cervical and lumbar regions, and backwards in the dorsal and sacral regions. When the curves have appeared the spine loses some of its flexibility. There is considerable movement in the cervical and lumbar regions, but very little in the dorsal.

## CURVATURE OF THE SPINE

There are four forms of curvature, *viz.* :—

Scoliosis or lateral curvature.

Kyphosis or posterior curvature (increase of the normal curve backwards).

Angular curvature, which is hump-back, caused by disease in the vertebral column.

Lordosis, or anterior curvature (increase of the normal curve forwards in the lumbar region).

## SCOLIOSIS

Scoliosis means twisting. It is a lateral bending of the spine combined with rotation or twisting of the vertebral bodies towards the same side as the convexity of the curve.

Scoliosis may be postural or structural.

*Postural Scoliosis.* Includes those cases where no bony changes have taken place in the spine, and the curve disappears when the patient is suspended.

It has been shown that correct posture is due to impulses from sense organs acting reflexly on certain muscles. Posture, however, depends to some extent on habit, and if bad habits are acquired, the muscles will learn to maintain the body in faulty positions.

If a child assumes a faulty position and the muscles after a time accustom themselves to it, the child begins to feel the faulty position is a right one. When corrected passively he will feel " not straight," and if told to correct himself he will return to the faulty position he has assumed. This then is the beginning of a postural scoliosis.

It is not due to muscle weakness, but to a deficiency of the normal reflex postural activity of the muscles. This leads to faulty attitudes, and "allows continuous strain to fall upon the passive structures (ligaments) of joints which were never intended to receive it" (*Bankart*).

As a result of the faulty positions the patient's spine falls to one side or the other. The deformity which occurs will depend upon the way the patient tries to correct his or her condition.

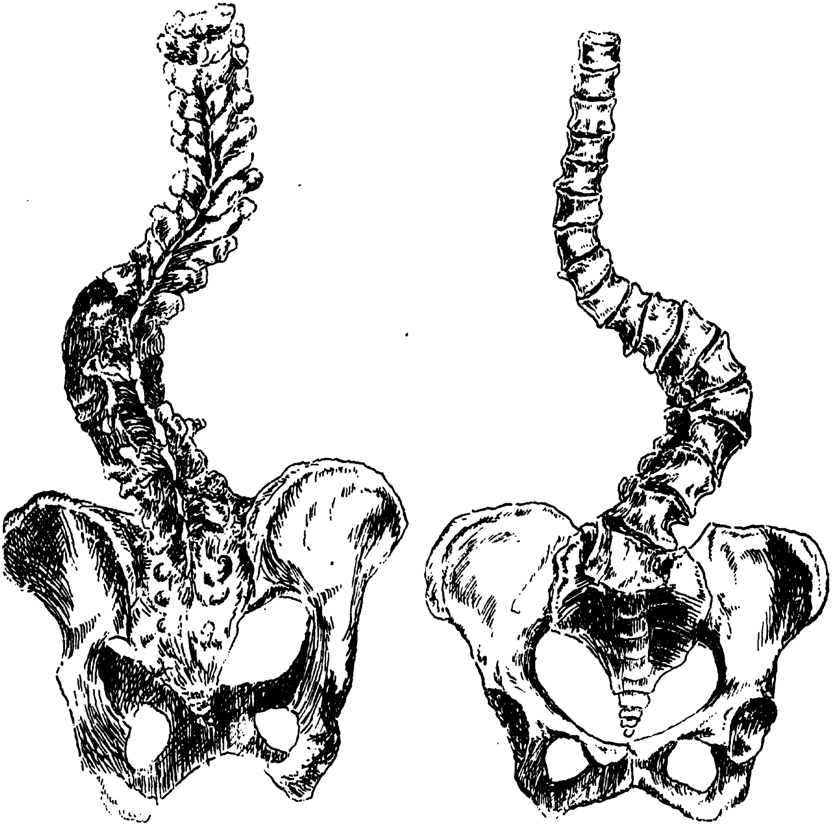

FIG. 100.—POSTERIOR VIEW. FIG. 101.—ANTERIOR VIEW.

STRUCTURAL SCOLIOSIS, SHOWING ROTATION OF THE VERTEBRÆ.

*After Brodhurst.*

*Structural Scoliosis.* Includes those cases where changes have taken place in the spine, and the curve does not disappear when the patient is suspended.

Some causes are:—Rickets, infantile paralysis, pleurisy, and empyema.

The structural form may also develop from a postural curve, and may be increased by one-sided occupations.

Scoliosis may also be produced by the shortening of a limb, the wasting of muscles, or by an injury to the thorax. The position which the patient assumes as the result of the disability will determine the nature of the curvature.

*Varieties of Scoliosis.* The curve is called cervical, dorsal, or lumbar, according to its position, and right or left according to the side of the convexity of the curve. A single or C-shaped curve is one where the spine deviates to one side only. It is also known as total scoliosis. A double or S-shaped curve is one in which the spine deviates to the right in one region and to the left in another. Sometimes a triple curve is seen.

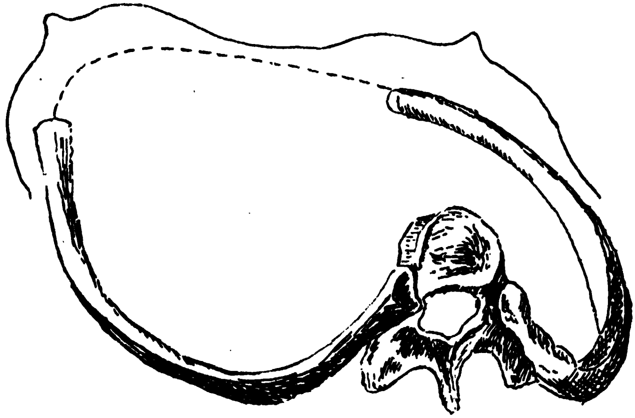

FIG. 102.—DIAGRAM SHOWING SECTION OF THE THORAX IN RIGHT-DORSAL CONVEX SCOLIOSIS.

*Copied by permission of Mr. Jackson Clarke.*

In any of these varieties changes may take place in muscles, ligaments, cartilages, and bones. The muscles and ligaments become stretched and weak on the convex side of the curve, contracted on the concave side. In severe cases the bodies of the vertebræ and the inter-vertebral discs become wedge-shaped.

*Cause of the Rotation of the Vertebral Bodies.* "The spine being a plastic weight-bearing column already curved in one plane cannot yield in another plane (*i.e.* to the side) without twisting, and in this twist the vertebræ can turn only one way, *viz.* away from the greatest weight and pressure, which is on the concave side of the lateral curve, so that they must turn to the convex side" (*Sir Robert Jones*).

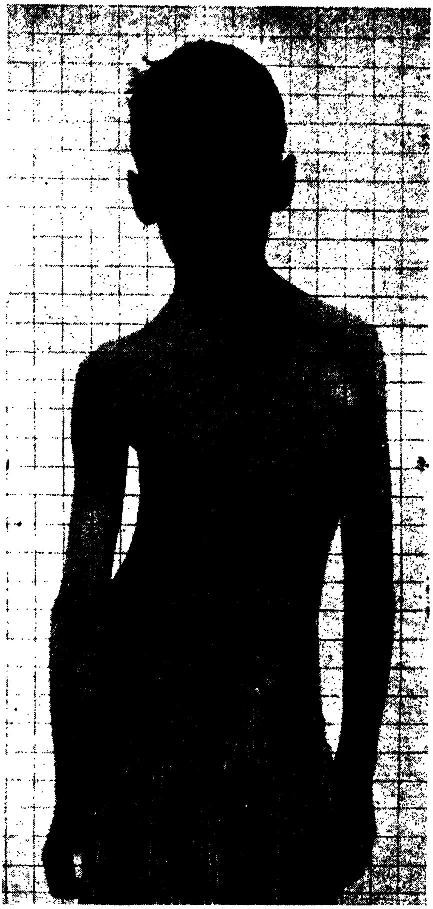

FIG. 103.—SEVERE STRUCTURAL RIGHT-DORSAL SCOLIOSIS.

*Signs of a Cervical Curve.* Deviation of the spine to the right or left. The position of the head is altered. The neck lines are uneven. One sterno-mastoid muscle may be contracted.

*Signs of a Dorsal Curve.* Deviation of the spine to the right or left. The scapulæ are uneven in height and may protrude backwards. The height of the shoulders is uneven (generally that on the convex side is higher). The angles of the ribs are altered. Back view: they protrude backwards on the side of the convexity; they are flattened on the side of the concavity. Front view: they protrude forwards on the side of the concavity, and are flattened on the side of the convexity.

*Signs of a Lumbar Curve.* Deviation of the spine to the right or left. The hips may be uneven. The waist angle is probably sharper on the concave side. The side of the back is broader on the concave side. If there is rotation of the vertebræ, the muscles will protrude backwards on the side of the convexity.

*How to examine Scoliosis.* The patient must be undressed to below the level of the hips and placed in a good light, standing with the feet slightly parted.

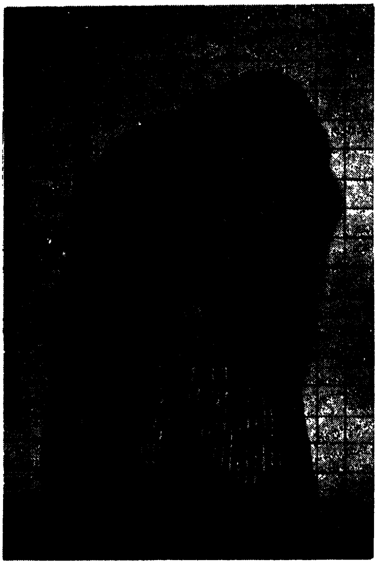

FIG. 104.—THE SAME PATIENT AS FIG. 103 IN FORWARD BENDING.

*The Back View.* Tell the patient to stand in her ordinary position (she will settle to this in a few seconds). Then notice the following points: The whole position of the body (it is often tilted to one side). The condition of the muscles. All the signs mentioned above according to the curve. Then let the patient curve the whole spine forwards as far as possible (lax stoop standing position) allowing the arms to hang down. Examine the spine carefully. In this position the signs of rotation are most easily seen. Next tell the patient to stand in the best possible position she can assume, and note carefully any changes. Now let the patient hang by her hands on a bar. A postural curve will straighten entirely when thus suspended, but if there are changes in the bones and the spine is very stiff, the deformity will still be seen.

*The Front View.* Notice the following points: The whole position of the body. The level of the hips. The condition of the abdominal muscles. Whether the chest is contracted. The position of the head and the neck lines. Measure the length of the legs from the anterior superior spine to the external malleolus. Measure the distance from the anterior superior spine to the umbilicus to determine whether there is rotation of the pelvis.

The general hygienic conditions and the patient's habits

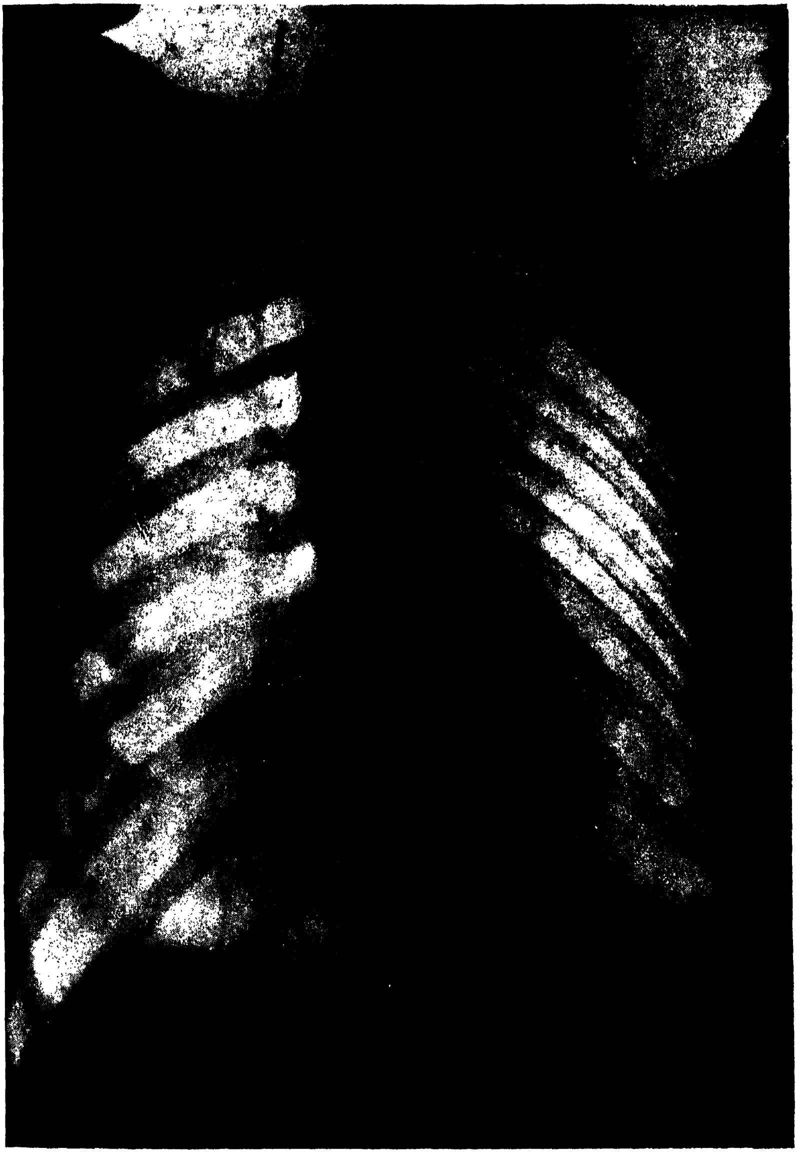

FIG. 105.—SKIAGRAM IN A CASE OF MARKED SCOLIOSIS, SHOWING ROTATION OF THE VERTEBRÆ, AND ATROPHY OF THE RIBS ON THE CONCAVE SIDE RESULTING FROM FUNCTIONAL DISUSE.

*From a photograph lent by Dr. Stanley Melville.*

must be regulated. The clothing must be warm, but should not restrict the patient in any way. A nourishing diet must be maintained. Plenty of fresh air and a proper amount of sleep are necessary. Rest, lying supine for from one to three hours, must form part of the daily programme. A firm couch or mattress should be used for this. The gymnast should take note whether the patient is sleeping in a suitable bed, and sitting in a proper position both during study and meals (see p. 62). A chair with a high back, that supports the whole spine and the head, is the best. A board placed on the chair forms a suitable substitute for the high back.

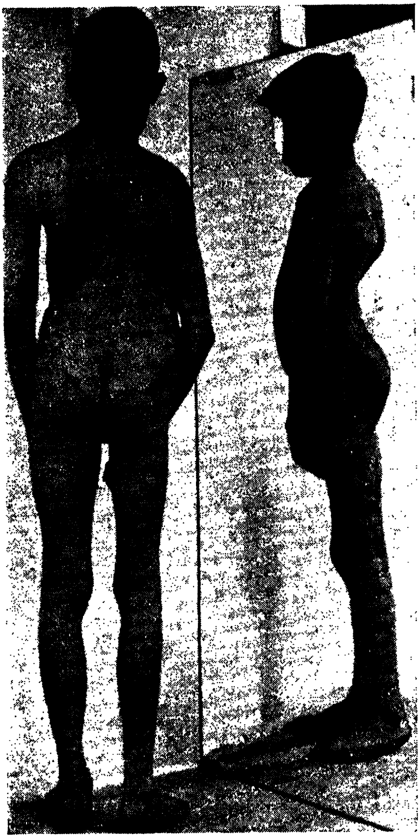

FIG. 106.—STRUCTURAL SCOLIOSIS. LATERAL VIEW SEEN IN MIRROR.

### GYMNASTIC TREATMENT

After careful examination of the spine, the patient may be drafted into a class to do free exercises with others having a similar disability. During treatment the patient's back must be uncovered, so that the gymnast watches the spine, and corrects faulty positions.

Some individual attention is also given, the gymnast choosing exercises for each patient. A table or scheme is written, and the treatment carried out two to four times weekly.

Home exercises are also taught and are performed daily.

Sometimes further individual attention is required, and a scheme is devised according to the position and severity of the curve. Back massage may be included. Rest should follow.

*Treatment of Postural Scoliosis.* The patient's "sensory appreciation" must be re-educated, by making him assume and realise a correct posture. This must be done before a mirror, so that he sees whether his posture is good or bad.

The correction must be maintained while simple exercises are performed. These are gradually increased in strength and difficulty.

Mobility of the spine is the next point to consider. Stiffness does not always occur, but if present, exercises must be chosen to overcome it.

It is important to influence the patient's mind, so that he or she takes interest in the treatment.

A table of exercises must include the following :—

(*a*) Deep breathing. The patient must first be taught the breathing (p. 146) in lying position ; later it may be given sitting or standing.

(*b*) Free double-sided exercises for arms and legs. Mobility movements for the head. Mobility movements for the trunk, *e.g.* trunk rolling, hewing and sawing.

Active arm and leg movements (pp. 111, 126). Chest expansion. An active correction for the head, *e.g.* head bending back and raising. Exercises for back and abdominal muscles (pp. 130–135). Passive stretching of the spine by hanging or head suspension, though it is important not to overstretch the muscles and ligaments. This must be followed by a corrective holding, *e.g.* leg forward lying, or wing stride stoop sitting holding. Sometimes double-sided resisted exercises, such as double arms flexion and extension ; double leg raising ; wing stride sitting, back raising ; wing sit-lying raising and sinking.

As soon as the patient has learnt a correct posture, balance walking should be done on a bar, or on a line on the floor.

*Treatment of Structural Scoliosis.* In these cases it is still necessary to teach the patient how to improve his posture and general appearance, and the deformity must be corrected as far as possible. The general health must be considered.

The treatment must continue for a considerable time, certainly as long as the deformity continues to improve.

*Aims of Treatment.* To improve the mobility of the spine and all small joints of the thorax.

To increase the breathing capacity.

To strengthen and tone up the muscles.

To passively stretch the spine.

To correct the deformities, by contracting the soft structures on the side of the convexities, and stretching those on the sides of the concavities of the curves.

To attain these aims, the treatment must include: Breathing exercises (p. 146); mobility exercises, *e.g.* trunk rolling, hewing and sawing (p. 118), etc.; passive stretchings, *e.g.* chest expansions; hanging, active corrections and holdings (pp. 89, 91); double-sided free exercises for the extremities; also others for the spinal and abdominal muscles (pp. 130, 132), also for the head and neck.

Balance walking is often useful.

In some severe cases of structural scoliosis, exercises are given to produce a compensating curve, which eventually improves the general posture.

But if the surgeon decides that further correction is impossible, he orders a spinal support or jacket, and sometimes a moulded plaster bed is made upon which the patient sleeps.

## SPECIAL EXERCISES FOR SCOLIOSIS

### SPECIAL EXERCISES FOR A CERVICAL CURVE

*Reach Grasp Sitting, Head Rolling to Mobilise the Spine* (p. 99).

*Suspension in Apparatus* (p. 241).

*Sitting Grasp Stool, Head Side Bending.* The bending is done actively with concentric and eccentric muscle work, the patient bending the head against slight resistance towards the convexity, and holding while the gymnast returns it to the starting position.

### SPECIAL EXERCISES FOR A DORSAL CURVE

*Leg-forward Lying. Holding.* With correction. This should be done with the back exposed, the gymnast directing, and obtaining the best possible position.

*Arch Leg Side Lying Holding.* The patient lies sideways on a high plinth, the pelvis resting at the end, and the legs fully extended. The uppermost leg lies behind. The feet are fixed with a cushion and strap. The convexity of the curve is uppermost, the concavity nearest the plinth. The arms are placed in wing or neck firm. With the gymnast's guidance the patient arches her spine towards the convexity, and holds in the corrected position.

*Wing Stoop Stride Sitting, Single Arm Up-stretching and Down-pressing* (p. 115).

*Right Talk Free Standing, Left Shoulder Lifting.* (For right dorsal curve.) The patient holds the right arm straight and outwardly rotated. The gymnast sits behind, and grasps the left wrist.

Against slight resistance the patient draws up the left shoulder, at the same time he must correct the dorsal curve at a point indicated by the gymnast. 4 to 8 times.

**Muscles Working Con. and Ecc.** Elevators of the shoulder on left. Side flexors of the trunk on right.

*Left Rest, Free Standing, Right Arm Downpressing and Relaxing.* The gymnast sits behind the patient, resists at the wrist with the left hand, and with the right indicates where the patient must correct his curve.

The patient presses the arm down against slight resistance, keeping the elbow straight. At the same time he draws in the muscles at the convexity of the curve, holds a short time and relaxes.

**Muscles Working Con. and Ecc.** The depressors of the shoulder, and side flexors of the spine on the right. 4 to 8 times.

*Note.* In both above exercises the muscles maintaining the standing position work statically.

*Forward Lying, Hands Clasped Behind, Dorsal Raising.* Progress to neck rest, yard and stretch positions, and later to leg forward lying.

**Muscles Working Statically.** Back muscles.

## SPECIAL EXERCISES FOR A LUMBAR CURVE

*Side Lying over Boom.* The patient lies on the boom with the pressure in the lumbar region.

*Hanging Double Leg Carrying towards the Convexity of the Curve and Holding.* A free movement, or the gymnast gives slight resistance at the ankles with one hand, supporting the hip on the opposite side with the other.

*Standing, Weight Carrying.* The patient must stand in a good position, the gymnast watching the spine. In response to the gymnast's command, the patient quickly bends the knee on the concave side, and so carries the weight of the body to the convex side. This corrects the curve. Repeat 6 to 12 times.

The spine must be fully stretched between each jerk. Useful as a between and home exercise.

*Lying, or High Reach Grasp Standing Hip Up-drawing.* The patient keeps the knee fully extended, and the gymnast grasps the ankle with both hands and resists, while patient lifts the hip as far as possible. The patient then resists while the gymnast draws the leg down to starting position.

It gives concentric and eccentric work for the muscles in use, and corrects a lumbar curve. Repeat 4 to 8 times.

*Spring Sitting Holding* (see p. 89).

*Heave Grasp Forward Lying, Single Leg Abduction with straight knee.* The leg is carried out as far as possible on the side of the curve, then returned to the starting position.

## Special Exercises for Double Curves

For a curve with convexity to right in dorsal region convexity to left in lumbar region and *vice versâ* :—

*Suspension in Apparatus* (see p. 241).

*Wing Stride, Lax Stoop Sitting, Back Raising.* At the end of the movement the patient holds in the corrected position. 4 to 6 times.

*Stretch Stoop Grasp Stride Standing Holding* (p. 241).

*Forward Lying, One Leg Carrying* towards the convexity of the lumbar curve. The gymnast lifts the legs from below and carries them round towards the convexity with small jerks. A second gymnast must fix the dorsal curve. Leg carrying may also be done in hanging position.

*Spring Sitting Holding* (see p. 89).

Klapp's crawling exercises may be added if required.

## Special Exercises to Correct Pelvic Rotation

*Hanging* gives a passive stretching and often helps considerably to correct the rotation.

*Crook Lying or Heave Grasp Close Standing. Pelvic Rotation.* The patient stands between two poles and holds these each side. For the latter position, the gymnast sits in front.

The following is given for a left lumbar curve with right hip forwards.

The gymnast places left hand behind the right hip and right hand in front of left hip. The patient then carries the left hip forward as far as possible. The gymnast then carries the right hip back to mid-line against the patient's resistance.

**Working Muscles.** The rotators of the trunk and the rotators of the pelvis (p. 86).

For the above movement it is the left trunk rotators, viz.: the left internal and right external abdominal oblique. The pelvic rotators are the right gluteus medius, and the left obturator externus and pyriformis.

The muscle groups during the movement work first concentrically and then eccentrically.

## KYPHOSIS

Kyphosis is an increase of the normal curve backwards in the dorsal region. It is generally combined with round shoulders and a contracted chest.

The muscles and ligaments on the posterior surface of the body become stretched and weak; on the anterior they tend to contract.

*Some Causes of Kyphosis.* Debility. Bad eyesight. Softening of bone caused by rickets. Slouching habits. Stooping occupations. Loss of reflex postural activity.

The kyphosis of adolescents is known as Scheuermann's disease. A lateral X-ray view shows "distinct wedging of anterior borders of affected vertebræ with fragmentation of the upper and lower epiphyseal plates" (McMurray). Scheuermann considers the condition is the result of abnormal pressure on the growing epiphyseal plates.

The patient should be examined as for scoliosis, and the following points noticed, after telling the patient to assume his ordinary position :—

Back view : The extent of the kyphosis, the position of the head, the position of the scapulæ, the condition of the muscles, and any deformity of the ribs.

Front view : The extent of the chest contraction, the position of the head, the condition of the muscles, including those of the abdomen.

Lateral view : The position of the head and shoulders, and whether the abdomen protrudes.

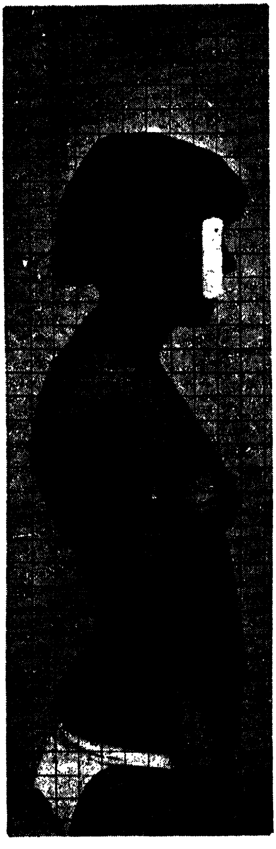

FIG. 107.—KYPHO-LORDOSIS.

After telling the patient to assume the best possible position, improvement by treatment may be expected according to the amount of correction possible by the patient's own effort.

General hygienic conditions must be considered as for scoliosis. Special attention should be paid to the clothes, so that the patient is not restricted in any way. Plenty of room should be allowed for chest expansion. If the eyesight is faulty, the eyes should be examined. Details of position during ordinary occupations are important.

### GYMNASTIC TREATMENT

*Aims of Treatment.* To improve mobility of the spine, to correct the deformity, and re-educate the postural reflex.

The table of exercises should include :—

Breathing.

Chest expansion.

Double-sided extremity movements.

Head and neck movements.

Passive stretchings of the spine, including movements to counteract lordosis.

Active corrections for back, shoulder and abdominal muscles.

Balance walking.

The patient should rest in crook-lying position, with a small hard cushion placed at the greatest point of the convexity of the curve.

## SPECIAL EXERCISES FOR KYPHOSIS

*Trunk Exercises to Increase Mobility of the Spine.*

*Chest Expansion* to stretch the soft parts on the front of the thorax.

*Hanging,* back against bars, so that shoulders are outwardly rotated.

*Hanging with Cushion.* The patient hangs with a small hard cushion placed between his shoulders and the bars. The strength of the expansion may be increased by the gymnast pressing the pelvis towards the bars.

*Head Suspension.* This requires special apparatus, with cords and pulleys suspended from a hook in the ceiling or fastened to a beam. There is a leather head piece which is fixed round the chin and back of head, and a horizontal bar above, which is gripped by the hands. The patient either stands or sits beneath the apparatus, while the gymnast gradually draws him up by means of the attached cord.

*Stretch Stoop Grasp Stride Standing Holding.* The patient stands facing rib-stools about two feet away. He gradually falls forward from the hips, and when the body is nearly horizontal he grasps the bars. The patient presses down, and at the same time contracts the back muscles. The head must be kept in correct position. The gymnast stands behind, and may correct by drawing on the pelvis somewhat.

*Forward Lying, Feet Fixed by Gymnast, Hands Linked Behind, Trunk Raising Backwards and Holding.* This is a static holding for back and hip extensors. Is used for young and weak patients.

*Wing or Neck Firm, Leg Forward Lying Holding* (p. 91).

*Wing or Neck Firm, Arch Leg Forward Lying Holding.* The same as last exercise, but stronger. The trunk is arched backwards. Sometimes the hands are clasped behind.

*Wing Stride Sitting, Back Raising* (p. 131). ending with strong correction and holding.

*Double Plane Arm Carrying* (p. 112).

*Heave or Stretch Grasp, Cross Leg Sitting, Holding.* The patient sits on the floor with back against rib-stools. A cushion is placed between the shoulders, and the hands grasp the bars above in heave or stretch position. The position is held 3 to 6 minutes.

*Head extensions* with concentric and eccentric muscle work are given in the following positions :—

Lying, head over end of support.
Reach grasp standing or sitting.
Hanging.

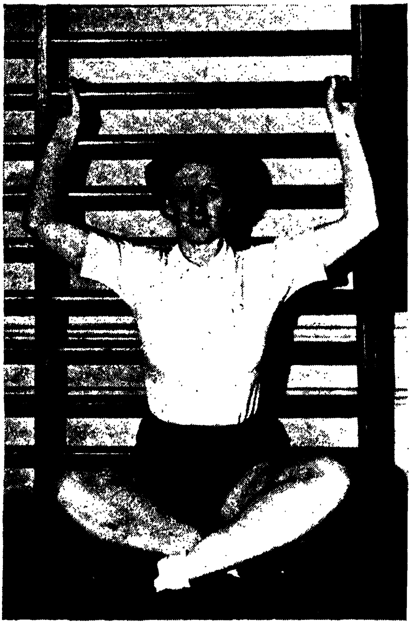

FIG. 108.—HEAVE GRASP, CROSS LEG SITTING, HOLDING.

*Arm Flinging* (p. 118).

*Shoulder-blade Exercise* (p. 118).

*Breathing* (p. 146).

*Crook Lying, over Small Hard Cushion.*

The cushion is placed at the greatest point of convexity, and the patient rests in this position.

*Talk Stride Kneeling, Trunk Forward and Downward Bending, till forehead touches the floor, rounding the back. Dorsal Raising,* gradually uncurling till the body is raised half way. The patient then flattens the back as much as possible and holds the position.

*Note.* Toe-touching exercises should not be used. It is maintained that such movements cause a depression of the anterior aspect of the vertebral bodies.

The following may be employed as an alternative :—

*Heave Grasp Lying, Double Leg Lifting* (knees straight) *and Carrying Over* (p. 127).

## LORDOSIS

Lordosis is an increase of the normal curve forwards in the lumbar region. The muscles and ligaments on the anterior side of the body become stretched and weak, those on the posterior contracted. Lordosis is rarely seen alone, it is generally described as a symptom of some other condition, *viz.* with congenital dislocation of the hips; as a compensating curve to kyphosis; as the result of rickets.

The patient should be examined as for kyphosis; the lordosis is best seen in the lateral view. The abdomen protrudes, owing to muscle weakness.

If the condition is caused by congenital dislocation of the hips, gymnastic treatment is useless, but if from other causes, improvement may be gained.

### Gymnastic Treatment

Correct the position of standing. Give mobility exercises and stretchings of the spine by hanging and cross leg sitting, holding, active work for abdominal muscles, also double leg flexion and lifting (carrying the legs over the head). General corrective position, and balance walking.

The patient should rest in crook lying position trying to press the lumbar spine against the plinth. Also with knees drawn up on to the abdomen and clasped with the arms.

### Special Exercises for Lordosis

*Hewing* (p. 118).

*Sawing* (p. 118).

*Cross Leg Sitting Holding* (p. 242).

*General Corrective Position* (G.C.P.). The patient in stride standing leans against a suitable support, first bending the trunk forward and allowing only the sacrum to touch. Gradually he raises, allowing each part of the spine to extend against the support till the head touches. When possible the feet are placed nearer the support, but the spine must still touch everywhere. The position is held 3 to 6 minutes.

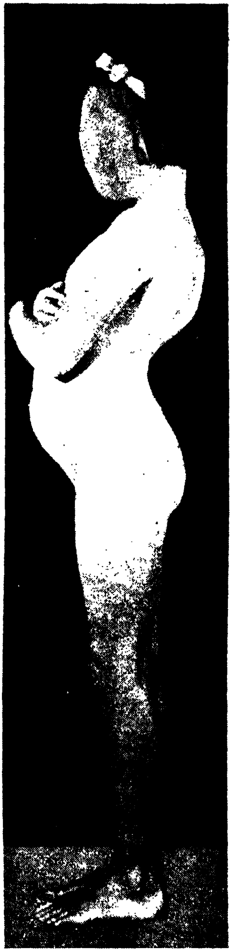

Fig. 109.—Lordosis.

*By permission of the London County Council.*

During the raising the extensors of the spine work concentrically. During the holding the abdominal muscles work statically.

*Heave Grasp Crook Lying, Double Knee Up-drawing and Down-pressing.* For single knee up-drawing and down-pressing, see p. 124. Here the gymnast gives resistance on both knees together, and presses them back only to the crook position. When both legs are moving, the abdominal muscles work concentrically and eccentrically, as well as the flexors of the hips. The strong flexion of hips and knees gives an extra stretching to the lumbar muscles.

*Heave Grasp Lying, Double Leg Lifting, and Carrying Over* (p. 127). The legs are carried over the head as far as possible. This gives an extra stretching to the lumbar muscles.

*Crook Lying Holding.* The patient lies thus, firmly grasping the knees with both arms. A small hard cushion may be placed under the pelvis. The position may be taken during rest for 5 to 10 minutes.

*Lying, Knee Bumping.* The patient flexes hips and knees to a right angle. From this positions the knees are drawn up sharply against the chest and back to starting position.

*Note.* As in kyphosis, no toe-touching should be used.

### ANGULAR CURVATURE OR HUMP-BACK

Angular curvature and its treatment have already been given in the chapter upon tubercular inflammation of bone (p. 162).

## Deformities of the Upper Extremities

### SPRENGEL'S SHOULDER

Sprengel's shoulder is a congenital elevation of the scapula. The bone is situated above its proper position and is somewhat rotated, and so a deformity arises. The lower part of trapezius and serratus magnus is often defective, but the muscles attached to the upper border of the bone are prominent. The arm on the affected side is usually smaller than its fellow, and scoliosis develops.

The condition is said to be due to abnormal uterine pressure.

*Treatment.* The muscles may require surgical treatment, otherwise aim at improving the general health, and correcting the scoliosis, specially treating weak and atrophied muscles. If the arm is small, give massage and movements to improve its nutrition and circulation.

### CONGENITAL CONTRACTION OF THE FINGERS

This is due to contraction of the central prolongation of the palmar fascia of the fingers. The little finger is the one usually affected.

*Treatment.* Surgical methods are sometimes necessary, but good results may be obtained by the use of a splint, and persistent massage and stretching movements.

### DUPUYTREN'S CONTRACTURE

Dupuytren's contracture is a condition caused by contraction of the palmar fascia within the palm, and resulting in a flexion of the first and second phalanges of the fingers.

It is usually seen in middle-aged men with gouty tendencies.

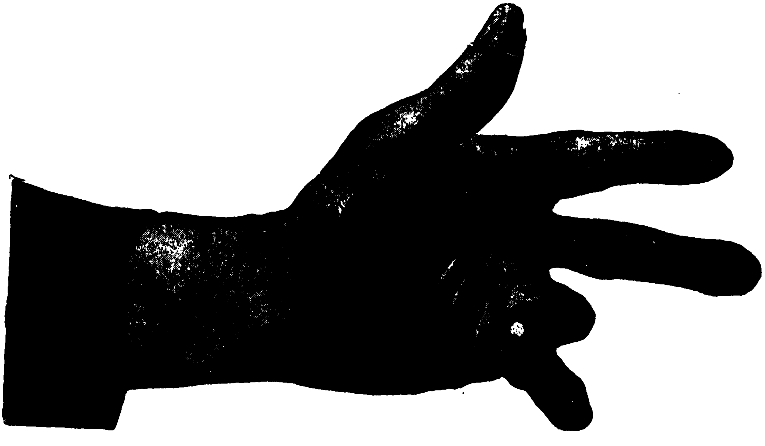

FIG. 110.—DUPUYTREN'S CONTRACTURE.

*By permission, from Rose & Carless's "Manual of Surgery" (Baillière, Tindall & Cox, London).*

Sometimes it seems brought on by the constant use of some tool such as an awl, but it may appear without this. It is due to a chronic overgrowth of the palmar fascia. It begins as a nodule beneath the skin, and generally affects first the ring and little fingers. These are gradually drawn down into the palm, and extension becomes impossible. Sometimes the other fingers and thumb are involved.

*Treatment.* This is surgical. The surgeon divides the fascia and straightens the fingers. Some form of splint is applied to keep the fingers extended, but this is removed for treatment. As soon as the wound is healed the hand may be massaged.

Stretching is done combined with active movements of all joints of the fingers and wrists.

The physiotherapist may devise special exercises to restore the full use of the hand.

Active movements of the elbow and shoulder should be added.

## Deformities of the Lower Extremities

### CONGENITAL DISLOCATION OF THE HIP-JOINT

The hip is the joint in which congenital dislocation most frequently occurs. Girls are more often affected than boys, and the condition may be unilateral or bi-lateral. The head of the femur is partially or completely displaced from the acetabulum. It may be a defective osseous or muscular condition, and the osseous type, which is the commonest, is generally due to a defect in the acetabulum.

During normal growth and development there appears on the rim of the acetabulum what is known as the supra femoral buttress. In congenital deformity cases the buttress is deficient and the cavity of the acetabulum remains shallow, instead of gradually deepening in the normal way.

If the femoral buttress is very defective, the dislocation may take place before birth as the result of inco-ordinated movements of the fœtus. In other cases the femoral head may still lie in the acetabulum at birth, but the dislocations occur soon after, when the child's legs are extended.

A third type will not develop deformity until the child assumes the erect posture and begins to walk. There is then a gradual displacement of the femora on to the dorsum of the ilia.

So these are the following three types :—

1. The ante-natal.
2. The pre-ambulant.
3. The post-ambulant.

In all these the head of the femur is dislocated upwards and backwards on to the ilium.

The acetabulum is shallower than normal, and it gradually loses its rounded shape. It becomes more a triangular depression. Eventually the acetabulum is filled with fibro-cartilage and covered by part of the joint capsule, while above a depression appears on the dorsum ilii, upon which the femoral head rests.

FIG. 111.—CONGENITAL DISLOCATION OF THE LEFT HIP-JOINT IN A GIRL AGED 7½ YEARS.

Both the head and neck of the bone change their shape, and in bilateral cases the pelvis is tilted forwards causing an increase of the forward curve of the spine in the lumbar region. In both unilateral and bilateral cases the corresponding innominate bone is not normally developed. The ligamentum teres is thin and slender, or it may be absent.

As a result of the mal-position there are changes in the muscles acting on the joint. Some become shortened, *viz.* adductors, hamstrings, gracilis, sartorius, rectus femoris and tensor fasciæ femoris. Others passing from the pelvis to the trochanter become stretched and elongated, *viz.* obturators, quadratus femoris and the psoas tendon. The gluteii become weak. The condition is not usually observed till the child begins to walk, when a slight limp is noticed. The walking gradually becomes worse. There is no pain, but movements in the joints are limited.

FIG. 112.—THE SAME PATIENT AS FIG. 111, 1 YEAR AND 8 MONTHS LATER AFTER REDUCTION AND TREATMENT BY FIXATION IN PLASTER.

If the condition is not corrected, in bi-lateral cases the patient walks with feet everted and with a duck-like waddle. There is marked lordosis and protruding abdomen, also the legs appear to be too short for the body. In unilateral cases there is a shortening of the affected limb.

*Trendelenburg's Sign.* This is looked for if dislocation is suspected.

*In Unilateral Cases.* If the child stands on the sound side, the buttock of the opposite side rises slightly, because gluteus medius contracts to raise the pelvis, in order to bring the body more directly over the limb. If the child stands on the dislocated side, the opposite buttock will drop. This is because gluteus medius is relatively inefficient and cannot raise the pelvis or keep it horizontal. The amount of drop depends on the degree of displacement.

*In Bi-lateral Cases.* The phenomenon is present on both sides.

*Treatment.* This is surgical. The dislocation is reduced with the least possible damage to the tissues, and it is essential that the reduction is maintained.

The child is kept with the hips abducted and externally rotated, and usually plaster of Paris is applied to maintain the position. The plaster is kept on for three months and then two more plasters are applied for similar periods, the position being altered each time and the legs gradually brought down and internally rotated.

X-ray examination is made at regular intervals. If the condition is satisfactory the plaster is removed and the movement gradually restored.

If the child is under twelve months, the legs are kept abducted by a wedge-shaped mattress or an adjustable splint.

In some cases an open operation is required. The surgeon creates a " bone shelf " which increases the supra-femoral buttress, the object being to prevent the head of the femur slipping out of the acetabulum after reduction.

*Physiotherapy.* After the removal of plaster and recovery from operations, movement is gradually restored. Radiant heat, massage and active movements may be ordered.

The legs are brought down by degrees to their normal position, and later the patient learns to walk.

Re-education and balance exercises must finally be taught.

Faradism to gluteus medius is sometimes given.

## COXA VARA

The neck of the femur connects the head of the bone with the shaft. It forms an angle which is wide in infancy, but gradually decreases. In the adult, this angle is normally one of about 125 degrees.

In the condition known as coxa vara the angle becomes changed. Instead of sloping obliquely upwards from the shaft, it becomes horizontal, and in bad cases is directed downwards.

This condition is seen in young children who have suffered from rickets, also in adolescents, where it may be the result of the same disease. It is, however, most frequently seen in young people who have had to walk much or carry heavy weights. Sometimes it occurs after a fracture of the neck of the femur in a child. It is then probably due to a yielding of the callus ; it may also be caused by a gradual slipping down of the epiphysis of the bone.

There is characteristic deformity, with shortening of the limb. The patient walks with a waddling gait, and has lordosis. The trochanter is prominent, especially when the hip is flexed. The movements of the joint are limited, especially internal rotation and abduction. During flexion, the limb sometimes lies across the sound one. In bad cases if both joints are affected a scissor-legged condition may be the result of the extreme adduction. Walking then becomes almost impossible.

*Treatment.* Rest is important, and to correct the deformity the patient may be placed on a double abduction frame, and the limbs fixed in slight abduction which is gradually increased. The position of internal rotation must also be adopted. Later massage of the limbs may be ordered also assisted and free movements in all joints.

Surgical treatment is resorted to in extreme cases. A wedge-shaped portion of bone is removed from the shaft below the trochanters, in order to alter the axis of the bone. When this is done, and the process of healing has taken place, massage may again be ordered. No hip movements should be given for from 4 to 6 weeks, and when allowed must be done with great caution.

The subsequent shortening of the limb if present may be corrected by wearing a thick sole on the boot.

### KNOCK KNEES OR GENU VALGUM

Genu valgum is a deformity of the knees. The internal condyles of the femur become enlarged, the legs are held in the position of abduction, combined with some external rotation. One or both legs may be affected.

In the normal standing posture the femur is set at an angle to the tibia, and the weight of the body is transmitted through the outer condyle. As a result the inner condyle becomes somewhat lengthened to keep the knee-joint horizontal, and some strain is therefore thrown upon the internal lateral

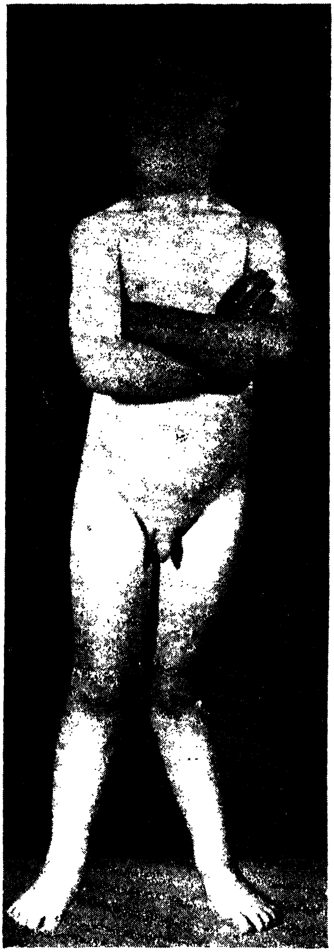

FIG. 113.—ANTERIOR VIEW.

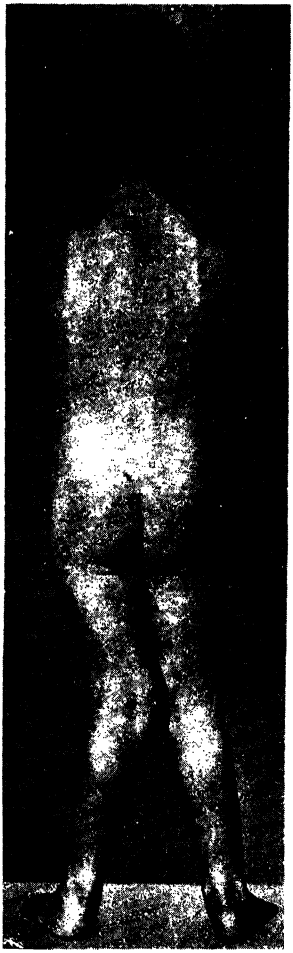

FIG. 114.—POSTERIOR VIEW.

KNOCK KNEES OR GENU VALGUM.

*By permission of the London County Council.*

ligament. In genu valgum the bones increase in size without the ligaments and muscles gaining a corresponding strength.

The internal lateral ligament becomes more and more stretched, the external condyle becomes compressed owing to increased weight, and the internal condyle enlarges.

The condition is often associated with flat foot and spinal curvature.

A child with lax knee-joints may seem to be knock-kneed when standing, *i.e.* bearing weight upon the joints, but if placed in lying position the deformity disappears.

*Causes.* In adolescents the condition is generally caused by much standing and walking, and by carrying heavy weights.

Some authorities consider the primary cause is due to loss of equilibrium between certain muscle groups in the thigh, *viz.* the internal and external rotators, and the abductors and adductors of the hip-joints.

In young children it is due to rickets. There is a traumatic form; it may occur after fracture of the femur or tibia close to the joint, or after a lateral dislocation of the knee.

The following points require special notice :—

1. Prominence on the inner side of one or both knees. This can be seen and felt.

2. The aspect of the legs when the patient stands : (*a*) with heels together—note, one knee falls in front of the other, the hip and knee being flexed ; (*b*) with the knees just touching —note how far the ankles are apart (normal distance about 1 inch).

3. The position of the patella. It may appear to be displaced outwards. This is due to the fact that it lies within the tendon of the Quadriceps muscle. This muscle is kept in a straight line from its origin on the anterior superior spine of the ilium to the tubercle of the tibia. Owing to the enlargement of the joint on the inner side, the patella appears to be pushed out.

4. The external lateral ligament of the knee, and the ilio-tibial band, which may be tense and contracted.

*Treatment.* If the deformity is due to rickets, the general condition of the patient must be considered.

Sunlight and cod-liver oil are ordered.

Sometimes splints are applied, but usually $\frac{1}{8}$-inch wedges are ordered on the inner side of shoes on both sole and heel.

In young children manipulation and pressure is given on the inner aspect of the joint, and counter-pressure on the outer side, below the joint.

*Exercises.* Cross-leg sitting, press the knees outwards. Half-lying, leg abduction and in-pressing on the outer side of the knee, and inner side of the ankle. This gives work for hip abductors while the position of the knee is corrected.

R. gr. st. toes inverted, heel raising and knee bending.

Flat-foot exercises may also be added.

In advanced cases an iron support is fixed to the boot on the outer side.

### BOW LEGS OR GENU VARUM

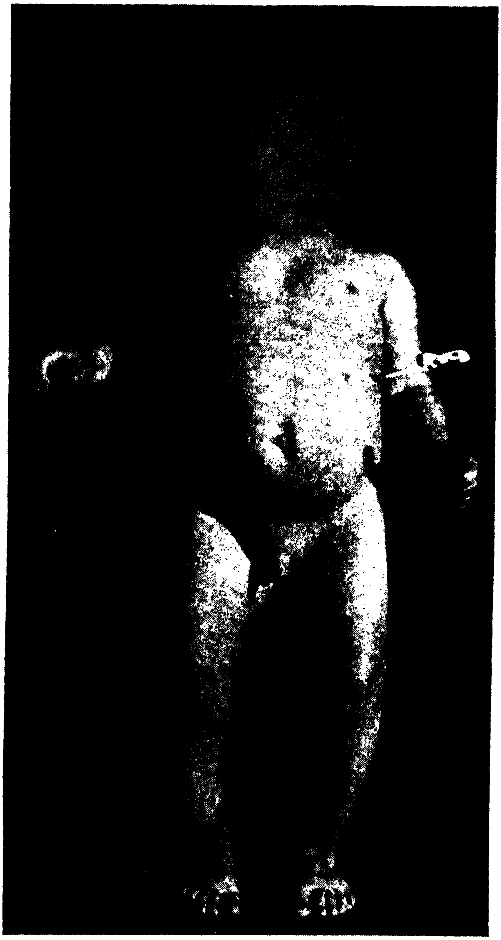

FIG. 115.—BOW LEGS OR GENU VARUM.
*By permission of the London County Council.*

Genu varum is not so common as genu valgum, and it is an opposite condition, *i.e.* the external condyles become enlarged and the internal compressed. The legs are bowed outwards. The knees will be separated, although the feet may be together. The adductors are probably weaker than the abductors.

*Treatment.* Sunlight and cod-liver oil.

In young children the limb may be moulded and corrected.

In severe cases splinting is ordered and sometimes massage is added. The adductor muscles should be stimulated by petrissage and active movements given to the same group.

The child must be kept off his feet.

## THE FOOT

The tarsal and metatarsal bones of the foot are so arranged as to form a series of arches. These are in the antero-posterior and transverse directions.

In the *antero-posterior* direction there are two arches known as the inner and outer.

The bones taking part in the *inner arch* are: os calcis, astragalus, navicular, the three cuneiforms, and the three inner metatarsals. This arch reaches from the tubercles of os calcis to the heads of the metatarsal bones. Owing to its height, and the number of small bones of which it is composed, this arch is very elastic. Its weakest point is where astragalus articulates with the scaphoid. It is here, however, supported on its under surface by the inferior calcaneo-scaphoid ligament, which contains a considerable amount of elastic fibres, and hence has been called the "spring ligament." The arches of the foot are supported further by internal lateral ligament of the ankle, the tendon of the Tibialis posticus muscle, the plantar fascia, the tendons of Tibialis anticus and Peroneus longus, and the small muscles on the sole of the foot.

*The outer arch* is composed of: os calcis, cuboid, and the fourth and fifth metatarsals. These are bound together by the long and short inferior calcaneo-cuboid ligaments, and strengthened by the outer extensor tendons, and the short muscles of the little toe.

*The Transverse Arch.* Across the middle of the tarsus the bones of each foot form half a dome, so that when the inner borders of the feet are placed together a complete dome may be seen. The arches vary in height in different types of feet.

A child is born without an arch to his foot. In his early years, the sole of the foot has a pad of fat within it, which gives the appearance of flat foot, but it is better described as "fat foot." It is not until the child begins to walk that the arches develop. "The correct attitude of the feet is maintained by the postural activity of the muscles acting upon them, and it is a part of the general postural reflex which maintains the upright position of the body as a whole" (*Bankart*).

### FLAT FOOT

Flat foot is a condition caused by sinking of the arches combined with eversion of the foot. The acquired type of flat foot is seen in young adults whose occupations have caused them much standing, walking, or the carrying of heavy weights. Flat foot occurs when these conditions are combined with rapid growth and poor general nutrition.

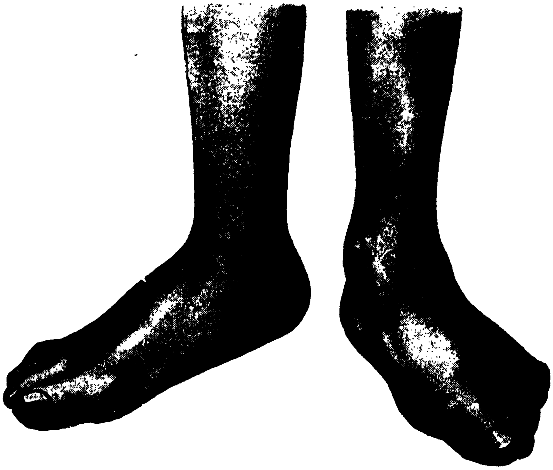

FIG. 116.—SEVERE FLAT FOOT.

*From "Short Practice of Surgery" (Bailey and Love), by permission of H. K. Lewis & Co. Ltd.*

The condition is also caused by loss of the normal postural reflex activity of the muscles.

Other causes are: after fractures or injuries to the foot or leg, rickets, and rheumatism.

The following changes occur :—

Lowering of the arches, combined with eversion of the foot. The ligaments, fasciæ, muscles, and tendons become stretched and weak. In severe cases there are bony changes, *viz.* a lengthening of the neck of astragalus; the head of astragalus (talus) and navicular become prominent.

The following important points should be noticed :—

1. The patient's method of walking, with and without boots.

2. Whether pain is present, and to what degree.

3. The patient standing with feet parallel, notice, from the front—the antero-posterior and transverse arches, the prominence of the head of astragalus, the inner malleolus, and scaphoid.

Notice, from the back—the prominence of the inner malleolus, also whether the tendon of Achilles is displaced outwards.

4. Take an impression of the sole of the foot by wetting or greasing.

5. Tell the patient to stand on tip-toes. Notice if the arch is improved thereby, and how steadily he can stand.

6. Tell the patient to stand on the outer borders of the feet, and likewise note the result.

7. The patient sitting, with the foot supported. Feel for all the tender points ; these will often occur on the sole and the dorsum of the foot, round the malleoli, and especially over the spring ligament. Notice if the patient complains of pain and aching of the calf muscles, also over the region of the internal lateral ligament of the knee, which may be strained.

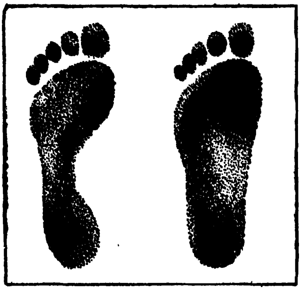

FIG. 117.—IMPRESSION OF SOLES. (*a*) NORMAL FOOT. (*b*) FLAT FOOT.

*From "Short Practice of Surgery" (Bailey and Love), by permission of H. K. Lewis & Co. Ltd.*

8. Try all passive and active movements.

It is most important to notice whether the foot is rigid and the patient therefore unable to invert the sole of the foot. The peroneii may be in a state of spasm, causing pain and further deformity.

*Degrees of severity in Flat Foot.* There are three.

*First degree.* The patient can himself correct the deformity.

*Second degree.* Active correction on the part of the patient is not possible, but this may be done by an operator.

*Third degree.* No correction is possible.

*Treatment.* This varies according to the type of flat foot, but in all cases it is essential to teach the patient the correct manner of standing and walking with the feet straight, so that the weight of the body falls on the outer longitudinal arch.

If the feet are painful, rest is an important factor, the patient should be told to avoid standing and walking. Massage is first given, paying special attention to painful spots. Passive movements in all joints of toes, foot, and ankle, later active, especially inversion with concentric and eccentric work. The physiotherapist also attempts to mould the foot with her hands into the inverted position, and urges the patient to " hold." The calf muscles are treated with stimulating massage. Later

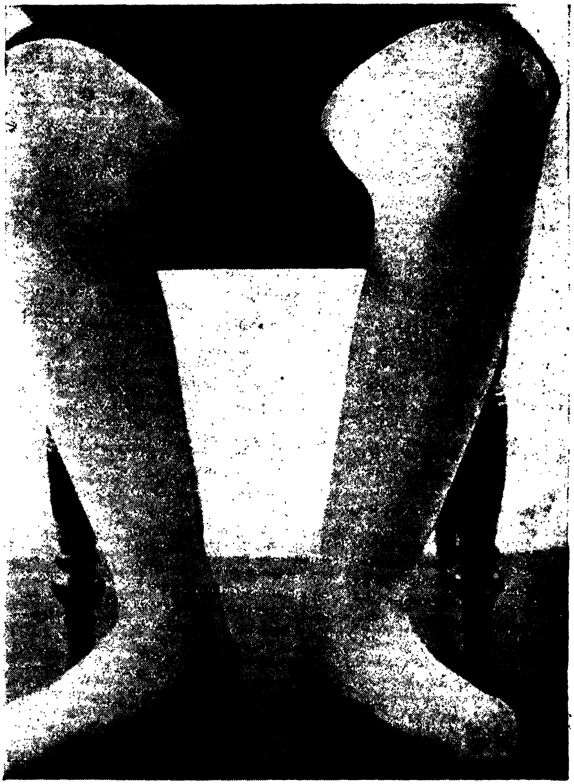

FIG. 118.—BOY OF TWELVE. FLAT FEET DUE TO ARTHRITIS OF TARSA JOINTS.

free corrective exercises are done in sitting, standing, and walking.

Faradic foot baths are given with great advantage.

In severe cases of rigid flat foot some surgeons advocate manipulation under an anæsthetic, and then encasing the feet in plaster for several weeks. When the plaster is removed the feet require massage and manipulation and re-education of the muscles by exercises.

Pain is often not present in the everted flat foot of a patient who has lost the normal reflex postural activity of the muscles. The correct position of standing and walking must be taught and systematic free exercises done twice daily.

### Free Exercises for Flat Foot

*Note.* The exercises are done without shoes.

1. *Sitting.* Support one foot across opposite knee. Fix ankle with one hand. With the other carry the foot in circles, *down and in.*

2. *In Same Position.* Manipulate foot and ankle, grasping with both hands.

3. *Tailor Sitting.* Grasp feet with a hand on each side and pull round.

4. *Sitting, Feet Parallel.* Raise on to outer borders, curl toes in as much as possible, hold thus and count four to twelve. Return to starting position. Repeat 4 to 12 times.

5. *Sitting, Feet Parallel.* Draw toes from a fixed line raising transverse arch. Do one foot at a time, 4 to 12 times.

6. *Sitting, Feet Parallel.* Toes parting and closing, 6 to 12 times each foot.

7. *Wing Standing. Feet Parallel.* Raise on to outer borders, curl the toes in, hold, count four to twelve. Return to starting position.

8. *Standing, Feet Parallel.* Raise slowly on to tip-toes while counting four. Slowly sink, while counting four. 4 to 12 times.

9. *Toes Inverted.* Repeat No. 8.

10. *Feet Parallel.* Heel and toe raising. 4 to 12 times.

11. *Feet Parallel.* Heel raising and knee bending. 4 to 12 times.

12. *Feet Parallel.* Draw toes from a fixed line. One foot at a time. 4 to 12 times.

13. *Stand with Feet over the Edge of a Platform or Step, at the Level of the Tarso-metatarsal Joints.* Bend the toes and foot down to the floor as far as possible, and raise again. 12 to 18 times.

### MARCHING EXERCISES FOR FLAT FOOT

These must be done along a strip on the floor, 3 inches wide and 4 yards long.

14. *Wing Standing.* Marching on outer borders. 3 to 6 times.

15. *Wing Standing.* Marching on tip-toes. 3 to 6 times.

16. *Wing Standing.* Marching on tip-toes, feet inverted. 3 to 6 times.

17. *Wing Standing.* Marching along strip. Heel toe, heel toe. 3 to 6 times.

18. *Wing Standing.* March on heels (to stretch tendo-Achillis). 3 to 6 times.

19. Marching, the foot creeping along the floor, drawing the heel towards the toes. Then reversing the action and creep back.

20. Marching, placing each foot: heel! outer border! toe!

### STRAPPING FOR FLAT FOOT

Strapping the foot with adhesive plaster often gives great relief. The strapping should be from 1 inch to 1½ inches wide, and 8 inches to 10 inches long. The foot is held strongly inverted. The strapping, beginning at the outer side of the foot at the level of the smallest toe, is made tense across the sole, and brought up obliquely over the inner ankle. Other strips may be added to strengthen this one.

Special boots, shoes, or insoles may be ordered by the surgeon.

### TALIPES OR CLUB FOOT

" The term Club Foot comprises those deformities in which the anatomical relations of the foot to the leg, or one part of the foot to the other, are abnormal " (*Tubby*).

The condition is associated with the loss of action or over-action of one or more groups of muscles concerned in the movements of the foot.

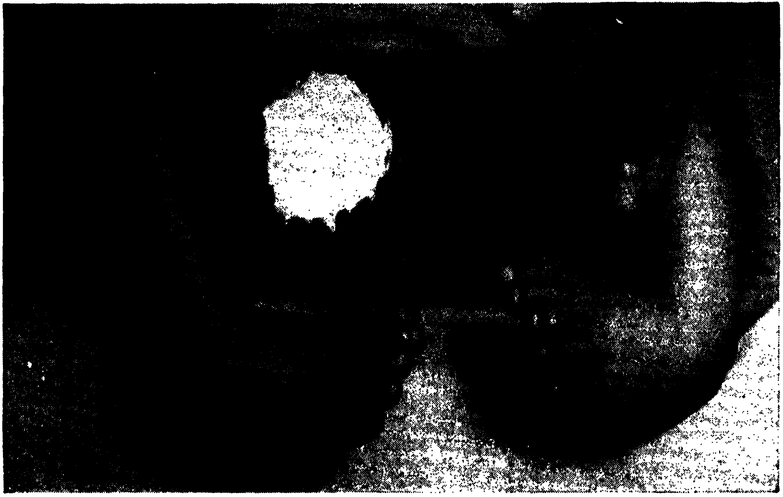

FIG. 119.—CONGENITAL TALIPES, EQUINO-VARUS.

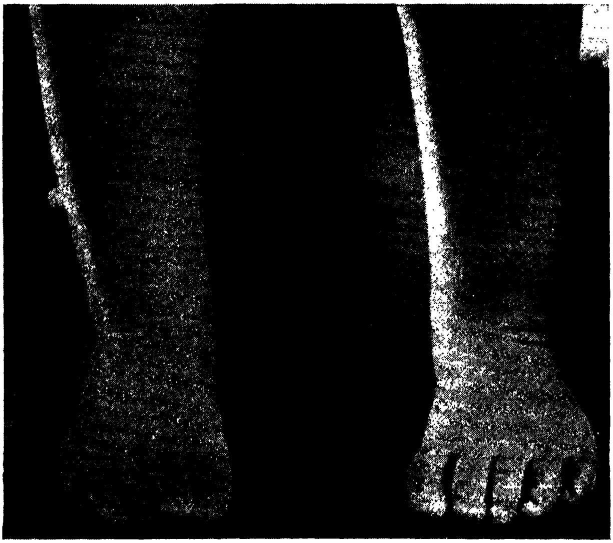

FIG. 120.—THE SAME PATIENT AS FIG. 119 AFTER OPERATION FOLLOWED BY MASSAGE AND EXERCISES.

Club foot may be (*a*) congenital, when the supposed cause is malposition in the uterus. (*b*) Acquired when the deformity is the result of paralysis or injury. Acute anterior poliomyelitis is a common cause.

### FORMS OF TALIPES

| | |
|---|---|
| *Equinus.* The heel is drawn up, the patient walks on the toes, *i.e.* the foot is plantar-flexed.<br>*Calcaneus.* The heel is on the ground and the toes are raised, *i.e.* the foot is dorsi-flexed. | The centre of movement is chiefly at the ankle-joint. |
| *Varus.* The inner side of the foot is raised, the patient walks on the outer border, also the foot is inverted or supinated.<br>*Valgus.* This form is due to a yielding of the longitudinal arch on the inner side of the foot. The foot is everted or pronated. | The centre of movement is at the ankle and medio-tarsal joints. |
| *Pes Cavus.* The convexity of the longitudinal arch of the foot is increased. | |

The first four types may be combined with each other in the following ways :—

*Equino-varus.* Very common.
*Calcaneo-valgus.*
*Equino-valgus,* } Uncommon.
*Calcaneo-varus.*

### Treatment for Congenital Talipes

An infant born with any of the above deformities should be brought for treatment when 7 days old. One of several methods may be adopted according to the wishes of the surgeon in charge of the case.

(*a*) Manipulations and bandaging the feet on to a splint of padded malleable iron.

(*b*) Correction of the feet and strapping.

(*c*) Manipulation and Mr. Dennis Browne's method of splinting, followed by wearing night boots designed by the same surgeon.

(*d*) Correction and application of plaster of Paris.

The child must be brought to a hospital or clinic at regular intervals. In some cases an intelligent mother can be taught how to continue between the visits. The child must be placed on a table, and the operator is seated in front.

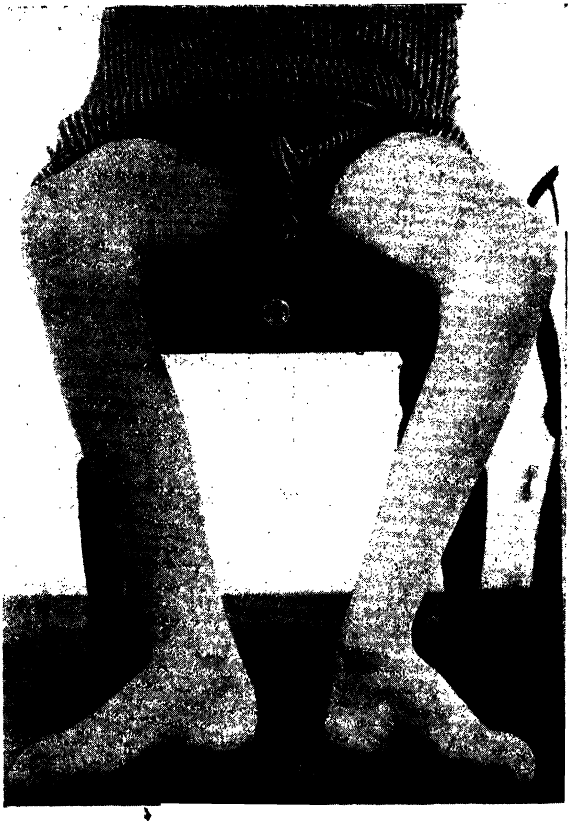

FIG. 121.—PARALYTIC TALIPES, CALCANEOUS.

Equino-varus is the deformity most often seen, and to manipulate for this :—

Grasp the right lower leg and heel with the *right hand* and manipulate with the *left.*

The foot must be straightened, strongly everted and dorsiflexed.

For the left leg the opposite holding is taken.

A calcaneo-valgus deformity is sometimes seen when the manipulations are given in the opposite direction. The manipulations are done daily, and if the malleable splint is used it must be well-padded and bandaged on the outer side of the foot and leg.

### Correction and Strapping

If strapping is more suitable, after manipulating and while holding the foot in correction, adhesive plaster 1 inch wide is applied. One end of the strapping is fastened on to the dorsum of the foot, carried across the sole and up the outer side of the leg.

A shorter piece may be placed round the leg below the knee to fix the first strip. A bandage is applied over the strapping.

The strapping must be replaced at least once a week and care must be taken to keep the skin clean and dry.

Small pads of adhesive felt are placed beneath the strapping :

(*a*) On the dorsum of the foot (inner side).

(*b*) On the plantar surface (outer side).

### Correction and the use of Mr. Dennis Browne's Splints

This method allows the use of the leg and foot muscles while the foot is splinted in the corrected position. When manipulating, the foot must first be forced round into full calcaneo-valgus position, until the little toe touches the outer side of the leg.

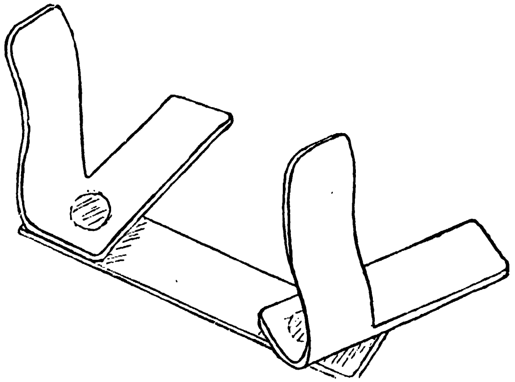

FIG. 122.—MR. DENNIS BROWN'S SPLINT FOR DOUBLE TALIPES.
*From " Royal Northern Operative Surgery " (H. K. Lewis & Co. Ltd.).*

Swelling probably occurs at first, but this subsides and the manipulation becomes painless.

Specially designed splints are applied.

The manipulation is continued once a fortnight and the splints reapplied.

These splints are continued for 6 to 8 months.

This type of talipes is very prone to relapse. Night splints should be worn for many months, and when the child starts to walk outside wedges to soles and heels should be added to day boots.

Supervision should be continued for many years.

## Correction and Plaster

Sometimes the corrected feet are placed in plaster of Paris. (This method is not used for very young children.) When other methods have failed to produce the desired result, or if the child has relapsed or not been treated early enough, then

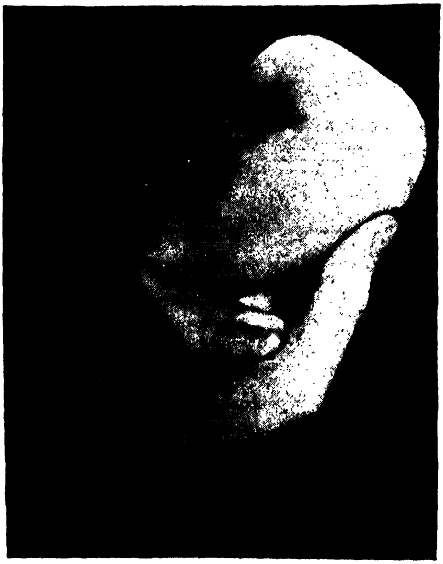

FIG. 123.—MANIPULATION OF FOOT. EQUINO-VARUS. FORCED INTO CALCANCO-VALGUS POSITION.

*From "Royal Northern Operative Surgery" (H. K. Lewis & Co. Ltd.).*

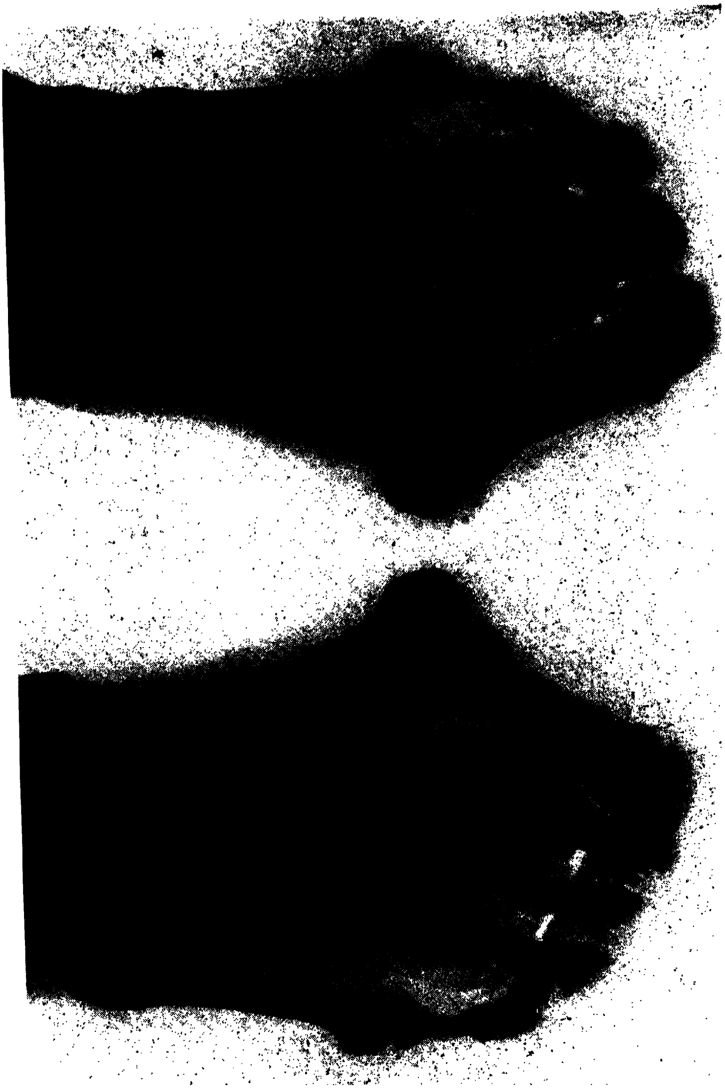

FIG. 124.—HALLUX VALGUS.

*From a photograph lent by the Worthing Hospital.*

the feet are manipulated under an anæsthetic, then placed in plaster in the corrected position.

It is important that when the limbs are taken out of plaster that massage (or galvanism or Faradism) be given to restore tone to the peroneal muscles.

Should the feet have been further neglected tenotomy and open operation may be necessary.

If the deformity has been caused by paralysis, tendons must be stretched with caution.

### TREATMENT FOR PES CAVUS (in adult)

1. Mobilise the foot with manipulations.
2. Faradism, the patient sitting and placing foot on a pad on the floor. Another fixed on the dorsum of foot. The current thus given strengthens the Lumbricales.

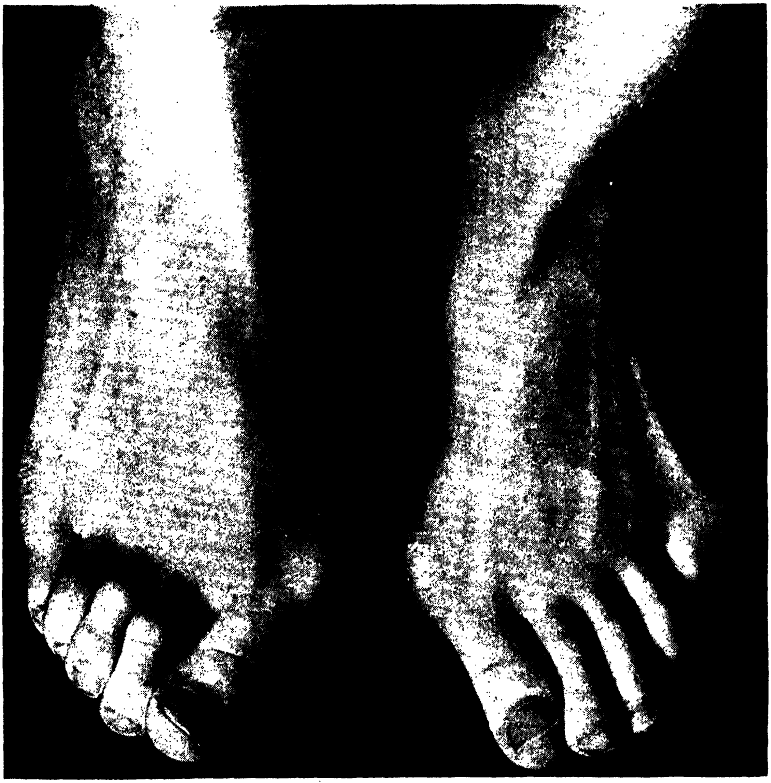

FIG. 125.—HALLUX VALGUS.

*From a photograph lent by Mr. John Cholmeley, F.R.C.S.*

3. The patient is instructed to (*a*) flex the toes over the edge

of a stool at the metatarsal-phalangeal joints (keeping toes as straight as possible).

(*b*) With whole foot on the stool, the patient bears down the weight of the body upon it, bending strongly in ankle and knee.

### HALLUX VALGUS

The metatarso-phalangeal joint of the great toe often becomes deformed generally due to the wearing of ill-fitting shoes.

In hallus valgus the great toe is displaced outwards, it is abnormally abducted from the midline of the body, and the joint becomes stiffened and enlarged.

The condition which is known as a bunion is often very painful. Mild cases may be relieved by the wearing of a suitably large shoe. A stocking with a specially divided toe, and sometimes a night splint is ordered.

Severe cases are treated surgically, the enlarged head of the metatarsal bone being removed.

Later all movement in the joint must be encouraged, and flat foot exercises added when the patient is allowed to stand and walk.

# *PART III*

## CHAPTER XXII

THE ALIMENTARY TRACT :—Constipation—Dyspepsia or Indigestion—Gastritis—Acute—Sub-acute—Chronic—Dilatation of the Stomach—Gastric ulcer—Enteritis—Colitis—Appendicitis—Visceroptosis or Glénard's Disease—Gastroptosis—Movable or Floating Kidney—Hæmorrhoids or Piles.

### THE ALIMENTARY TRACT

WHEN food enters the stomach it is passed along the alimentary canal by means of peristaltic action. This is a wave-like movement caused by contraction of the muscles of the whole tract. The stomach contents are forced into the small intestine, through which it passes and eventually reaches the colon. The contents travel faster in the stomach and small intestine, the rate of the muscle contraction in the colon being the slowest. The residue of the digestive products reaches the sigmoid colon in about twenty-four hours after food has been taken. The fæces accumulate there and as the result of further stimulation they are forced into the rectum. The act of expelling the contents of the bowel is known as defæcation. The muscular action is controlled by nerves connected with centres in the lumbar spinal cord. There are also impulses from the brain to certain voluntary muscles which contract strongly and help in the act of expulsion. Persons in ordinary health have an action of the bowels once daily ; though this may vary and normal health be maintained. Habits of regularity regarding evacuation of the bowels are of importance to all.

Experiments have been made showing accurately the time which the contents of the lower bowel take to pass from the cæcum to the rectum. It is a well-known fact that food taken, or sometimes only thought of, will give stimulation to the lower bowel, increase peristaltic action, and cause an evacuation which is the result of food taken some twelve hours previously.

## CONSTIPATION

Constipation may be defined as infrequent and incomplete action of the bowels, combined with retention of the fæces within the colon, owing to their slow passage from the cæcum.

*Causes.* (*a*) Weakness of abdominal muscles, also of Levator ani and other pelvic muscles. (*b*) Sedentary habits. This is a usual, but not an absolute cause, for constipation is often met with in people who lead an active life. (*c*) The continued use of purgative drugs. (*d*) The habitual disregard of the impulse to defæcate. (*e*) Errors in diet, *e.g.* too little vegetable food, too much meat, not enough liquid. (*f*) Certain nervous diseases—melancholia, hysteria, all brain diseases, paralysis, etc. (*g*) Chlorosis, *i.e.* the anæmia of young girls. (*h*) Lead poisoning.

*Symptoms.* These may vary from nothing to extreme illness. Some or all of the following may be present: The bowels act at irregular intervals. The rectum is loaded. There is ineffectual straining. Bad appetite, flatulence, foul tongue and breath, pain in the iliac region, piles, headache, and anæmia.

*Aims of Treatment.* (*a*) To increase the blood supply to the abdominal organs and so improve the portal circulation.

(*b*) To promote peristaltic action.

(*c*) To improve the tone of the intestinal muscles which may have become weakened, and to strengthen the muscular walls of the abdomen.

(*d*) To stimulate the secretion of bile, gastric and intestinal juices.

*Treatment.* The cause must be removed as far as possible. Habits tending to produce constipation must be corrected. The patient should be told to attempt defæcation at the same hour daily. If there is difficulty and straining, a low seat should be used, or the feet raised by a foot-stool, in order to resemble the natural attitude as far as possible. Suitable exercise should be taken daily.

Diet, drugs, and general hygiene are regulated by the doctor, but it is well known the following are beneficial in these cases:—A tumblerful of hot or cold water taken on waking, also during the day between meals, and at bedtime. Some animal food should be taken, and a good proportion of fresh vegetables and ripe fruit, also well-stewed fruit. Oils and fats should be taken in sufficient quantity, if they do not disturb the digestion. Coarse articles—*e.g.* bran or wheatmeal bread, oatmeal porridge, etc.

*Massage and Exercises.* The patient's age and condition must be considered.

Abdominal massage when ordered should be stimulating and be administered in the early part of the day, from 10 to 25 minutes. Beginning with deep breathing, and including manipulations to :—

(*a*) *Stomach.* Stroking, kneading, friction, shaking.

(*b*) *Liver.* Stroking, kneading, beating, pounding, squeezing.

(*c*) *Intestines.* Stroking, transverse and circular kneading. Colon stroking, kneading, friction.

The descending colon should first be treated. Both the kneading and frictions, starting in the left iliac fossa. The work over the transverse portion should be light, but considerable attention given to the ascending colon.

Fæcal masses may be felt, but it is not wise to attempt forcibly breaking them, the manipulations must be gentle and rhythmical, their object being to increase peristalsis, and to mechanically help on the contents of the colon.

Transverse abdominal shaking, lumbar side shaking.

The abdominal wall should receive picking up and kneading movements.

Deep breathing is repeated.

Contractions of abdominal muscles and those of the pelvic floor may be added, and later the following free exercises :—

Lying, head raising and sinking, trunk bending sideways and trunk turning.

Lying, leg rolling for circulation and constipation ; single and double leg flexion, concentrically and eccentrically.

Later the patient is given a table of exercises which may be done in the bedroom or gymnasium. It should include deep breathing and active trunk and extremity movements, the aim being to help the circulation generally, and especially to bring blood to the abdomen—to strengthen all muscles forming the abdominal walls and to give a mechanical stimulation to the organs.

Exercises may be chosen from the following :—

Deep breathing.

Leg rollings; also active movements for the hips, working the flexors and adductors concentrically and eccentrically.

Trunk rolling. Sacral beating.

*Sacral Beating.* The patient stands leaning forward upon some support. The physiotherapist stands on the left side, placing her left hand over the patient's abdomen, with the right hand she performs a series of beatings in the sacral and gluteal regions.

Two rows of seven beats are given on each side, and one row of five. The latter are given nearer the centre.

The series is repeated 2 to 4 times, followed by deep stroking.

The beating is always given over the patient's garments. The gluteal muscles must not be contracted during the process.

Sacral beating stimulates the abdominal and pelvic organs, and the nerves supplying them.

Free active exercises, working the recti and oblique muscles; side bending, forward and backward bending, and trunk rotation exercises may also be included.

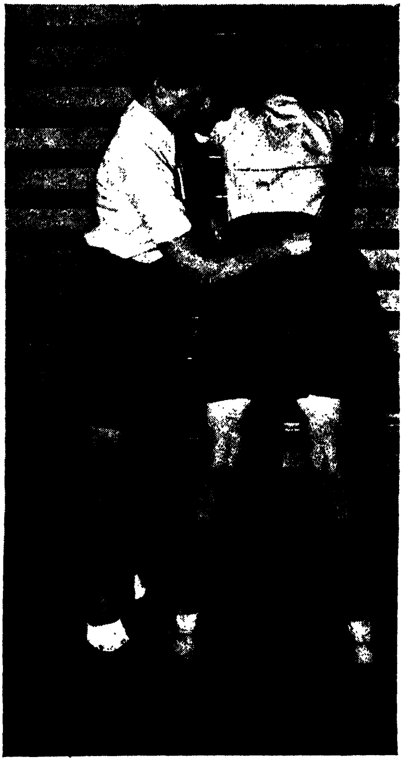

FIG. 126.—FORWARD LEAN STRIDE STANDING. SACRAL BEATING.

The following is a specimen table for a strong patient suffering from chronic constipation :—

To be given by the physiotherapist. 4 to 6 times weekly.

1. Crook lying deep breathing.
2. Half lying, leg rolling for circulation and constipation.
3. Wing stride standing trunk rolling.
4. High ride sitting trunk backwards falling and raising.
5. Crook lying deep breathing.

6. Wing close standing, alternate trunk turning.
7. Lean standing, sacral beating.
8. Crook lying, abdominal contractions.
9. Heave grasp lying double leg flexion.
10. Crook lying deep breathing.

Abdominal massage, 15 minutes.

Specimen table of home exercises :—
To be done by the patient daily.

1. Crook lying, deep breathing.
2. Lying, alternate knee up-drawing and outstretching.
3. Crook lying, abdominal contractions.
4. Crook lying, head raising and sinking.
5. Wing stride standing, trunk rolling. 6 each direction.
6. Standing deep breathing.
7. Wing close standing, trunk rotation to right and left.
8. Half yard grasp standing, leg swinging.
9. Stretch stride standing, trunk bending forward and downwards.
10. Standing deep breathing.

## DYSPEPSIA OR INDIGESTION

Dyspepsia or indigestion may be defined as variable changes from the normal functions of any part of the digestive tract. Such changes will speedily affect important processes in the body such as absorption of digested food and the elimination of waste products, and hence general metabolic changes will take place.

The causes are : (*a*) improper food ; (*b*) changes in muscles of the alimentary canal ; (*c*) changes in the digestive secretions.

*Symptoms.* These may be very numerous. Some of the commonest are : constipation or diarrhœa, vomiting, flatulence, foul breath and tongue, eructations (*i.e.* expulsion of gas from the stomach upwards, sometimes with portions of liquid or solid food), changes in feeling which may vary from a feeling of weight or discomfort to severe pain, headache, giddiness, insomnia, impaired appetite, etc.

*Treatment.* Removal of the cause, regulation of the diet, and general hygiene, will be in the doctor's hands.

General massage may be ordered to improve nutrition and circulation. Much effleurage and muscle kneading should be given. Joint movements and breathing exercises are also useful. Constipation should be treated by abdominal kneadings. Flatulence may be relieved by much stroking over the stomach. Gastric secretions may be increased and the walls of the stomach strengthened by stomach shakings and vibrations. The liver should be treated to improve its functions. If headache and insomnia are present, head, face, and back massage may give relief.

Later a table of exercises may be given for general strengthening.

## GASTRITIS

**Acute Gastritis** or gastric catarrh is " acute inflammation of the coats of the stomach, especially of the mucous membrane, resulting in a disturbance of function, and alteration of form " (*Gillespie*).

The causes of this condition are :—

Errors in diet, irritants, *e.g.* alcohol. Constitutional conditions, *e.g.* gout, rheumatism, and diabetes.

*Symptoms.* Severe pain in the gastric region, a burning sensation, a feeling of weight in the stomach, tenderness on pressure. Intense nausea, and vomiting. The temperature rises, the skin is pale and cold, the patient is prostrated.

*Treatment.* This is in the hands of the doctor. Physiotherapy is entirely contra-indicated.

**Sub-acute Gastritis** is " inflammation of the mucous membrane, less severe than in the acute form, of moderate duration and variable course " (*Gillespie*).

This condition is seen most commonly in women between the ages of fifteen and thirty. It is often associated with anæmia. The causes may be the same as those of acute gastritis, but they occur more gradually. If treated wrongly, or not at all, such cases will become chronic.

*Symptoms.* Similar to those of acute gastritis, but less severe. There is epigastric pain and vomiting, flatulence and nausea, and a distaste for food, but there is not the complete prostration, and no rise of temperature. Many cases of so-called dyspepsia come under this heading of sub-acute gastritis.

*Treatment* is again in the hands of the doctor. Massage may be ordered for the improvement of general condition.

Vigorous general massage may be given, with the exception of abdominal treatment, which is contra-indicated.

**Chronic Gastritis.** " A chronic inflammatory affection of the various cellular elements in the gastric mucosa, leading to increase of connective tissue and loss of function " (*Gillespie.*)

This chronic form often follows the acute and sub-acute attacks, but the condition may also occur as a result of repeated irritation of the mucous membrane by errors of diet, such as alcohol, strong condiments, an excess of tea, indigestible foods containing much cellulose, taking food too hot and at irregular times.

*Symptoms.* Very variable. The following are among those commonly present :—Feelings of gastric weight and fullness after food. Flatulence, acidity, heart-burn, nausea, and vomiting. Foul breath and tongue. Intestinal changes, *i.e.* constipation or diarrhœa. Lowering of the general nutrition, and sometimes nervous depression.

*Treatment.* The diet must be carefully regulated. Harmful foods, *e.g.* highly seasoned, pickled, or smoked articles, must be avoided.

Massage and exercises may be given as for dyspepsia. Aim at improving general nutrition and helping the portal circulation. Abdominal massage must begin gradually, avoiding tender spots. Much soothing stroking over the stomach is useful.

## DILATATION OF THE STOMACH

Dilatation of the stomach means an enlargement of the organ. It is generally combined with atony, *i.e.* a general want of tone in the muscle fibres.

The condition may be caused by some obstruction such as a tumour or by adhesions around the pylorus, or within the stomach as a result of ulceration.

Dilatation also occurs from excessive muscular weakness. This may be caused by much work being thrown on the stomach, *e.g.* large meals repeatedly taken for a long period. The condition is often found in patients suffering from neurasthenia, chronic gastritis, dyspepsia and anæmia.

There are changes in nutrition when the stomach is dilated. There is diminished digestion and assimilation of food. The food remains long in the stomach and may undergo bacterial fermentation, whereby it is changed into substances which cannot nourish the body.

*Symptoms.* Pain and discomfort in the region of the stomach. Flatulence and gaseous eructations. Vomiting often takes place four to six hours after food ; it is preceded by pain and a burning sensation. The quantity brought up varies, but may be as much as six pints. Ejection of the contents of the stomach gives immediate relief.

*Treatment.* The doctor often orders a systematic washout of the stomach, by inserting a soft tube, and pouring in two or three pints of liquid containing some boric acid, bicarbonate of soda, etc. The diet must be carefully regulated. Large quantities of liquid must not be taken. Food must be fresh and digestible.

If physical treatment is ordered general massage may be given to improve circulation, and general nutrition ; and abdominal massage with special movements for the stomach —stroking, kneading, shaking and vibrations.

As the patient improves, carefully graduated exercises are added to improve circulation and peristalsis, and to strengthen the abdominal walls and the intestinal muscles.

## GASTRIC ULCER

" A disease of the stomach characterised by the presence of an ulcer of varying depth, beginning in the mucous coat and attended by pain, vomiting, and hæmatemesis " (*Leith*).

The ulceration mostly affects the mucous membrane of the stomach, but when the ulcers become deep the muscular coats and the peritoneum may be also involved. The results of this condition are varied. The ulcer may heal without complications. It may leave a scar which contracts. The stomach may become fixed by adhesions. There may be perforation, which leads to peritonitis.

*Symptoms.* Severe pain in the region of the stomach. This may continue after the ulcer is healed and is then due to scar contraction involving nerves. Vomiting, dark red in colour, due to blood mixed with mucus. Black fæces, also due to blood. Tenderness over the region of the stomach. Flatulence.

The medical treatment of this condition varies according to the severity of the symptoms. Massage is not ordered in the early stages, but during convalescence its use is beneficial. The whole body may be treated except the abdomen, where no massage is allowed for at least two months after the ulcers have healed. Even then no manipulations should be given over the stomach, but if constipation is present the colon may be cautiously treated. Nothing must be done which in any way could tear adhesions or open a scar.

## ENTERITIS

Enteritis is inflammation of the small intestine. It varies in intensity from the simple catarrh to such grave conditions as suppuration and ulceration.

The treatment is entirely in the hands of the doctor.

**Chronic Enteritis.** The changes occurring within the intestine are similar to those in the stomach in chronic gastritis. Digestive symptoms arise due to alterations in the intestinal juices, both in quantity and quality. There is an excess of mucus, diminished peristalsis, less absorption, and a lowering of general nutrition. The condition may be caused by chill, errors in diet, or changes in the circulation. It is most common in children.

*Symptoms.* Diarrhœa or constipation. Abdominal pains. Flatulence. Mental depression. The fæces contain undigested food, mucus, and sometimes blood.

*Treatment.* Warmth and rest. The diet must be carefully regulated.

General massage may be given for improving nutrition and circulation. Special abdominal treatment to relieve constipation by strokings, kneadings, and colon frictions. Stimulating Movements—*e.g.* lumbar side shaking, cross abdominal shaking, if the patient can bear them. Tender spots must be treated with caution. If the abdomen is distended, the manipulations must be very gentle. If diarrhœa is present, only vibrations over the whole abdomen may be applied.

## COLITIS

Inflammation of the colon, in various degrees of intensity, is called colitis. The following are important varieties :—

**Ulceration of the Colon.** This condition is present in dysentery and typhoid fever, but it is also seen independently of these diseases.

*Symptoms.* Diarrhœa; blood is present in the fæces. Constipation at intervals. Abdominal pain, distension, and tenderness. The tongue is furred. The temperature may rise. There may be emaciation and anæmia, and cardiac failure is sometimes a result.

This condition is serious and its treatment entirely in the hands of the doctor. Complete rest in bed is ordered.

**Chronic Catarrhal Colitis,** often called **Mucous Colitis.** This may accompany enteritis. It is often characterised by the passing of large quantities of mucus. The condition usually occurs in people of nervous dispositions, with a tendency to dyspepsia and neurasthenia.

*Symptoms.* Some or all of the following may be present:—Constipation. Diarrhœa accompanied by the passage of blood and mucus. Griping pain. Distension of the abdomen and tenderness to pressure on some part of the colon. A furred tongue, nausea, and vomiting. Sometimes slight fever is present.

*Treatment.* This should follow the same lines as those laid down for enteritis. The patient's mental attitude must be considered.

General massage may be given to improve nutrition and circulation, also to influence the nervous system.

Abdominal treatment requires special attention. Much kneading, and colon frictions to relieve constipation. Vibrations over tender areas. Stimulating movements, *e.g.* cross abdominal shaking and lumbar side strokings, if the patient can bear them.

Later a general strengthening table of exercises is added, including breathing, gentle extremity movements, and carefully graduated abdominal movements. Those which take blood from the abdomen by stoop positions, and those for back and gluteal muscles. If constipation is present these would be omitted and the following added: leg rolling, sacral beating, and active abdominal exercises.

Diarrhœa may be quieted by vibrations over the abdomen.

## APPENDICITIS

Appendicitis is inflammation of the vermiform appendix. There are inflammatory changes in the mucous membrane, which extend to the outer coats. Later adhesions may form.

The inflammation may go on to suppuration and perforation, causing abscess and peritonitis.

The condition may be due to continued constipation, to a foreign body stationary in the appendix, rheumatism, gout, etc.

*Symptoms.* Constipation, abdominal pain, specially in the right iliac fossa, vomiting, swelling and tenderness in the cæcal region. The temperature rises.

*Treatment.* This is generally surgical. The vermiform appendix is removed. In some cases, however, the patient recovers from an attack and the operation is not done.

*Physical treatment* may only be given during convalescence if the appendix has been removed. The outlines given (p. 141) for post-operative treatment may be followed, viz. :—

Massage and passive movements to the limbs and active muscle contractions, and later exercises.

If constipation is persistent abdominal massage may be given, when the wound is healed. Stroking movements to relieve flatulence, then the stomach, small intestine and colon are treated, and though the manipulations must be deep enough to be effective, they must be done with much care and gentleness. The operation scar must not be over-stretched, but if it seems adherent to the underlying parts, careful friction may be given around it, working towards the centre.

The following are suggested tables of treatment :—

Two weeks after operation (in bed).

1. Half-lying, deep breathing.
2. Half-lying, arm kneading and active movements (5 minutes each).
3. Half-lying, contractions of gluteal muscles and those of the pelvic floor.
4. Lying, head raising and sinking.
5. Lying, alternate trunk side-turning, throwing the arm over chest.
6. Lying, deep breathing.
7. Lying, alternate knee-raising, placing foot on the bed, and sinking.
8. Lying, abdominal contractions.
9. Half-lying, leg-kneading + foot rolling and act. foot flex. and ext. inversion con. and ecc. (10 minutes each).

Four weeks after operation (the patient is up).

1. Half-lying, deep breathing.
2. Half-lying, gentle leg rolling.
3. High ride sitting, trunk bending sideways.

4. High ride lax stoop sitting, trunk-raising to vertical.
5. High ride sitting, deep breathing.
6. Wing close standing, alternate trunk turning.
7. Reach grasp standing, alternate knee-lifting.
8. Sitting, alternate heel and toe-raising.
9. Crook, half-lying, abdominal and gluteal contractions.
10. Crook, half-lying, deep breathing.

Abdominal and back massage if necessary.

For details of ward exercises and post-operative treatment see p. 140.

## VISCEROPTOSIS OR GLÉNARD'S DISEASE

Visceroptosis is a falling of the abdominal viscera. "The normal relations of the viscera to each other and to the parietes is maintained by the elastic pressure of the anterior abdominal walls, by suspensory bands of peritoneum, by the attachment of viscera to each other, and by the support afforded by blood-vessels. The whole abdominal contents may occupy a lower and more anterior position than normal. The action of gravity will produce this effect whenever the muscles of the anterior abdominal walls are permanently relaxed from want of tone or from previous over-stretching. General visceroptosis is therefore much commoner in, though not confined to, the female sex. It is sometimes associated with hernia, and has been attributed to over-exertion and to straining in habitual constipation" (*Shaw*).

**Gastroptosis** is a sinking of the stomach from its normal position. This often takes place combined with a sinking of the other abdominal viscera, or the stomach may be displaced alone. The condition may occur when the organ is healthy, but is more frequently seen during dilatation. In such cases the greater curvature of the stomach has been found to reach almost to the pubes.

*Symptoms.* These are variable, and are often associated with a nervous condition. The functions of any of the displaced organs may be interfered with, resulting in dyspepsia, vomiting, constipation, attacks of colic, etc.

*Treatment.* The cause must be removed. This is possible if there has been pressure from above. The clothes should be suspended from the shoulders. If the cause is weak abdominal walls, much can be done to restore their strength and tone. An abdominal belt is often ordered.

During abdominal massage and any exercises given in the lying position the plinth or bed should be raised 2 to 4 inches at the lower end.

Massage manipulations are done in an upward direction as much as possible. A special movement is given by placing the hands above Poupart's ligament on each side, and a vibration pressure is given in an upward direction which helps to lift and replace the organs.

The patient must learn deep breathing and contractions of the abdominal and pelvic floor muscles. These must be practised daily.

A suitable table is also given including such exercises as :—double leg flexion, double leg lifting, trunk bendings and turnings, circle turning, head raising and breathing exercises. The patient should rest with the pelvis and legs raised.

## SPECIMEN TREATMENT FOR VISCEROPTOSIS

### TABLE A

*Position.* Lying, lower end of couch raised.

1. Deep breathing.
2. Abdominal and pelvic floor contractions.
3. Head raising and sinking (without pillow).
4. Alternate trunk side bending.
5. Double knee up-drawing and replacing to crook position.
6. Deep breathing.

Abdominal massage. 15 to 20 minutes.

### TABLE B

1. Lying deep breathing.
2. Lying double-leg flexion, concentrically and eccentrically.
3. High ride sitting trunk side bending.
4. High ride sitting backward drawing to vertical.
5. High ride sitting deep breathing.
6. Lying head raising, with double-knee up-drawing.
7. Crook lying, sacral lifting, quick pelvic turning to R and L.
8. Crook lying, abdominal and pelvic floor contractions.
9. Crook lying, deep breathing.

Abdominal massage. 15 to 20 minutes.

## MOVABLE OR FLOATING KIDNEY

A sinking of one of the kidneys within the abdominal cavity. The right is more often affected than the left.

The normal kidneys move considerably with respiration. This movement may increase to a variable degree, the increase may be slight, or the mobility so marked that the organ can be moved about freely in the abdominal cavity. This is called a floating kidney. The condition is more prevalent in women than men. It is usually due to absorption of fat in the lumbar region, within which the kidneys are embedded. The causes are :—lax abdominal walls, sudden strains or injuries, etc.

The patient is often of a neurasthenic type, and is generally thin and emaciated.

*Symptoms.* Often there are none, and in nerve cases it is inadvisable for the patient to be told the position of the kidney is abnormal. There may be dull aching pains in the abdomen and lumbar region, and sometimes abdominal distension.

Digestive and hysterical symptoms are often present.

The kidney may be felt to move under the hand through the abdominal wall from the front.

*Treatment.* If no symptoms are present, no treatment is required. Pain and discomfort are often removed by wearing a belt with a suitable pad. Massage is sometimes ordered to help the general condition. Abdominal massage is given after the kidney has been replaced by the physiotherapist. This is done by placing one hand firmly under the patient in the lumbar region, and the other beneath the kidney, pressing gently inwards and upwards from the front abdominal wall. All abdominal treatment must be given with caution, for any manipulation tending to increase the mobility of the organ would be harmful.

Exercises may be added as for visceroptosis.

## HÆMORRHOIDS OR PILES

Hæmorrhoids or piles are varicose veins at the lower end of the bowel. They take the form of protruding masses inside and outside the anal opening. The hæmorrhoidal veins are liable to become dilated and varicosed. It is a common condition in people of middle age and advanced years, and a symptom of certain cardiac, hepatic, and uterine

## TYPES OF ENTEROPTOSIS, AS SEEN WITH THE OPAQUE MEAL.

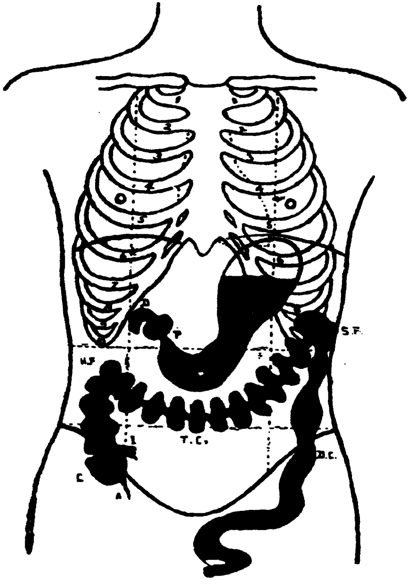

FIG. 127.

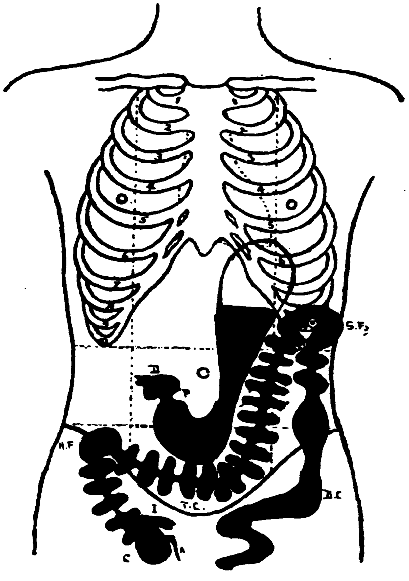

FIG. 128.

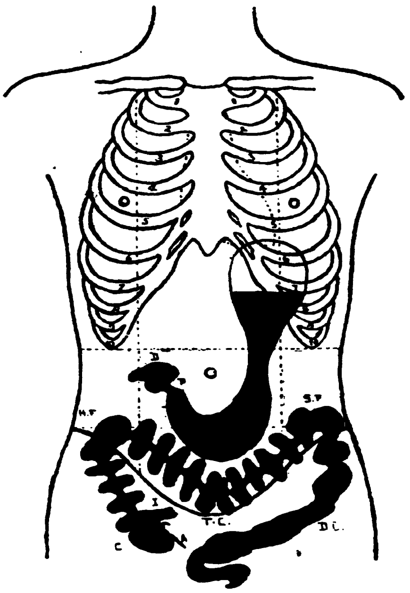

FIG. 129.

FIG. 127.—NORMAL POSITION OF STOMACH AND COLON. (ERECT.)

FIG. 128.—PTOSIS OF STOMACH AND RIGHT HALF OF THE COLON. SPLENIC FLEXURE IN NORMAL POSITION. (ERECT.)

FIG. 129.—PTOSIS OF STOMACH AND WHOLE OF COLON.

P. Pylorus. D. Duodenum. C. Cæcum. H.F. Hepatic Flexure. T.C. Transverse Colon. S.F. Splenic Flexure. D.C. Descending Colon. I. Ileum. A. Appendix.

diseases. Hæmorrhoids also occur as a result of the straining of constipation.

*Symptoms.* Pain on action of the bowels. Bleeding which may result in anæmia. Pain in the back and general ill-health.

*Treatment.* No physical treatment can be given locally.

If constipation is present, abdominal massage may be given cautiously; anything vigorous, *e.g.*, leg rolling, should be avoided.

# CHAPTER XXIII

RHEUMATIC DISEASES :—Main groups—Acute and sub-acute rheumatism—Still's disease—Chorea or St. Vitus's Dance—*Non-articular rheumatism* — Fibrositis — Panniculitis — Muscular rheumatism — Stiff neck—Pleurodynia—Lumbago—Fibrositis of head—*Articular rheumatism* — Rheumatoid arthritis — Osteo-arthritis — Infective arthritis—Climactericarthritis—Gout—Chronic Gout—Spondylitis.

## RHEUMATIC DISEASES

RHEUMATIC diseases cover a wide range of conditions differing from each other in greater and lesser degrees.

Writers on the subject use a varied classification and terminology, but the main groups of the diseases are :—

A. ACUTE AND SUB-ACUTE RHEUMATISM.
B. NON-ARTICULAR RHEUMATISM.
C. ARTICULAR RHEUMATISM.

### ACUTE RHEUMATISM

Acute rheumatism or rheumatic fever is characterised by fever, sweats, inflammatory changes in the joints with frequent involvement of the heart (see endocarditis, p. 328). The joints attacked during the course of the disease are bright pink, painful and tender. One attack makes a patient more liable to other attacks.

The treatment is medical. Massage is never employed at this stage.

Children and young adults are especially liable to attacks of acute and sub-acute rheumatism.

### SUB-ACUTE RHEUMATISM

The sub-acute form does not " flare up " in the same way as the acute, and it may be unrecognised for a considerable time.

Many authorities consider that the condition is associated with a streptococcal infection. There may be mild degrees of fever, sweating, and frequently heart symptoms are present. The joints may escape altogether, but the heart is nearly always involved. The insidious nature of the complaint constitutes its chief danger, especially to the heart.

The condition may occur at any age, but children of the poorer classes are very liable to contract the disease. Girls are more affected than boys, and it seems to be caused by damp and cold, bad housing conditions, improper clothing (the child is often over-loaded with garments), and may sit in school in wet shoes and damp clothing.

The rheumatic symptoms are more generalised in children than in a similar condition in the adult. The fever is usually not so high, the arthritis may be severe, slight, or absent. The skin may show rheumatic rashes. The nervous system is affected; this varies from slight irritability to a condition known as chorea where there are uncontrolled and incoordinated movements. So-called growing pains are often present. These may take the form of cramp, or of aching in the thighs, behind the knees, and in the ankles and wrists. The child may complain that he or she cannot walk, and after sitting cannot stand up. It does not, however, follow that every child complaining of growing pains is rheumatic. Rapidly growing and debilitated girls and boys may have pain in their limbs. Those caused by debility usually only affect the legs. They come on with exertion and generally subside with rest, while the rheumatic pains may occur any time during the day or night and affect both arms and legs. The child may be kept awake, and cry for hours with pain.

In the rheumatic condition nodules are present. They are fibrous lumps lying in the subcutaneous tissues, and are usually freely movable over bony prominences. They are commonly found around the elbow, over the patella and occiput. They may be painful and tender.

*Treatment.* Complete rest in bed for from three to twelve weeks, with attention to elimination of poison through the skin and bowels. The throat, which is often the source of infection, must receive suitable attention.

During the period of rest in bed, the prevention of deformity is very important, so the limbs are kept in a neutral position on splints, or in a plaster moulding.

If the temperature has subsided, physical treatment may begin.

Gentle massage is sometimes ordered, but it is important to teach the patient contraction and relaxation of the muscle groups (see p. 64). This may be done while the limbs still lie at rest on the splint.

Assisted active movements are given in the joints within the limit of pain, and later the patient progresses to free active movements. Much support should be given to the limbs during the movements either by slings, or by using the method of re-education described in Chapter VII. Each joint should be carried to its full range once daily to prevent stiffness.

Treatment is gradually increased to general exercises, thus preparing the patient to return to normal life.

Throughout he must learn to co-operate with the physiotherapist, and take an interest in his progress.

Signs of fatigue or any heart symptoms must be noted. An increase of the pulse rate usually indicates that the treatment should be modified or stopped.

The patient should rest between the exercises and after the treatment.

Also after a course of treatment, a period of rest is often desirable.

For notes on heart treatment, see p. 330.

### STILL'S DISEASE

Still's disease is a rheumatic condition in children, usually occurring between the ages of three and seven years. It differs

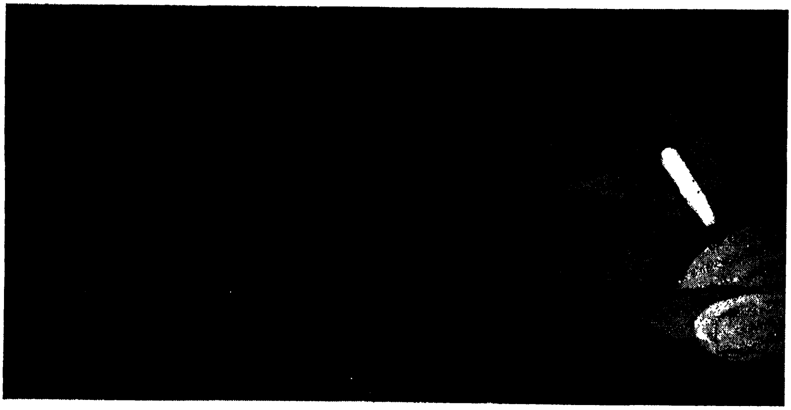

FIG. 130.—GIRL AGED EIGHT. STILL'S DISEASE. SHOWING ENLARGEMENT OF KNEES, ELBOWS, HANDS, AND FINGERS.

from acute and sub-acute rheumatism in that, while the joints are affected, the heart is rarely involved. With the slowly progressing arthritis, however, there is marked muscular wasting, and serious limitation of movement in the joints. The spleen and lymphatic glands are enlarged and some pyrexia is present.

*Treatment.* This should follow the same lines as for sub-acute rheumatism. Attention must be paid to the general debility of the patient.

### CHOREA OR ST. VITUS'S DANCE

Chorea is a nervous disturbance which, as already mentioned, often occurs in the milder varieties of sub-acute rheumatism, but it may follow measles and other diseases of childhood.

It is mostly seen among children of the poor, so that want of proper food and neglect are predisposing causes. It may also be the result of fright and over-work at school. Girls are more often affected than boys, and it usually occurs between the ages of eight and twelve.

In women the condition sometimes accompanies pregnancy, but recovery as a rule takes place after delivery.

Chorea is characterised by irregular, involuntary movements of almost every part of the body, which increase with excitement but cease during sleep.

*Symptoms of the mild form.* In the early stages there are slight twitchings in the face, and spasmodic jerky movements of the hands and arms. The condition is first described as " fidgets." When the child is conscious of being observed the movements increase. There is slight loss of muscle power, the child dropping things she takes in her hands. The diaphragm and muscles of the chest and abdomen are affected, causing irregular respiration. When rheumatism is the cause, heart symptoms may appear. A cardiac murmur is usually found, due to mitral incompetence.

There is often a change of temperament ; a good-tempered child becomes cross and irritable. There are emotional disturbances, such as night terrors and sleep walking. The mental capacity and the power of concentration are lessened. In some cases one arm or the face only is affected.

*Symptoms of the severe form.* The movements become greatly exaggerated. Grimaces, contortions, and jerkings are continuous. Deglutition and speech are interfered with. The intellect is sometimes affected and there may be paralysis.

*Treatment.* In the severe forms, complete rest in bed is essential. The patient must be kept very quiet, see no other children, or be excited in any way. Suitable diet and drugs are administered.

*General Massage* may be given and should be of a very soothing nature. It is often only possible to do effleurage with one hand, whilst the other supports and holds the affected limb. When the movements subside, a little gentle muscle kneading may be added. Soothing stroking down the spine is helpful.

When the jerky movements subside still more, or in the milder forms, general massage may be continued, but it should gradually be decreased and exercises given instead. These are begun in the lying position. Easy free double-sided exercises for co-ordination, breathing, and circulatory movements.

Later exercises with mild resistance are added. Balance walking, and marching in spaces. Methodical exercises in front of a looking-glass, the patient trying to refrain from jerks and grimaces for a quarter, then for half a minute. Later the patient tries to control finer movements in drawing and writing, also in threading needles, beginning with a bodkin and thread.

### SPECIMEN TABLE FOR A CHOREA PATIENT

1. Lying, deep breathing.
2. Arm bend half-lying, arm extension outwards slowly and back to shoulders. In time to counting.
3. Forward lying, free double-knee flexion and extension, and alternately. In time to counting.
4. Wing stride standing trunk bending forwards and raising.
5. Lying deep breathing.
6. Wing standing, balance walking on a 2-inch strip on the floor. In time to counting.
7. Crook lying. Head side bending and turning. The movements done freely by command.
8. Lying single-knee up-drawing—and outstretching.
9. Wing stride sitting, back raising—slight resistance.
10. Half-lying, double-arm flexion and extension—slight resistance.
11. Wing standing, marching in time to counting.
12. Lying deep breathing.

## NON-ARTICULAR RHEUMATISM

### FIBROSITIS

Fibrositis is an inflammatory condition of the white fibrous tissues of the body. It appears in the fibrous sheaths and supporting structure of muscles, around ligaments, fasciæ and tendons. When present in the subcutaneous fasciæ it is also known as Panniculitis.

It is only in recent years that this form of rheumatism has been termed fibrositis, and that "rheumatic" nodules have been described.

The condition may be the result of some acute infection, *e.g.* sepsis in tonsils or teeth, or it may be caused by metabolic changes, and damp and cold and occupations are also factors. The first change to appear in the tissues is local thickening. This may be present in strands or lines, especially in the gluteal muscles. It may be doughy and deep-seated, or it appears as plaques of thickening as in lumbago. There is also the well-known "fibrositic nodule."

*Symptoms.* Local pain, which may be intermittent or continual. There may also be referred pain.

There is always tenderness on pressure.

In acute stages there is muscle spasm.

There may be a painful fatigue in the muscles after exertion.

*Treatment.* This includes attention to general health and removal of causes if possible.

Various forms of heat are applied, and later on exercises, but by far the most important part of the treatment is massage, and the most important manipulation is friction. The painful thickenings and nodules must be found, and the frictions must be applied deeply. It will be painful at first, and after treatment there may be increased tenderness, but this decreases with further applications.

**Fibrositis of the Subcutaneous Fascia or Panniculitis.** It may be found in small areas, *e.g.* on the inner side of the thigh or knee, or it may be widespread. The skin and underlying tissues become thickened and dense. The new tissue which forms will contract as the result of cold, strain and fatigue, and the result will be aching and stiffness. The affected parts are painful to pressure, and the tissues bruise easily. There may be tender nodules and a creaking which may be felt when frictions are applied.

This condition often occurs in obese women and may be associated with thyroid deficiency. It is also found in thin people, and in their cases the parts affected are the scalp, the deltoids, the borders of the scapulæ, around tendo-Achillis and sometimes in the abdominal wall.

*Treatment.* The application of local heat and massage as already described must be continued for some time. Relaxation exercises are of value, and the patient is advised to take a course of treatment once or twice a year.

**Fibrositis of Muscles or Muscular Rheumatism.** There may be an acute inflammatory condition in the muscles and their tendons.

The condition is caused by cold, damp, overstrain of muscles and sometimes rupture of the muscle fibres, and other injuries.

Any of the voluntary muscles may be affected in varying degrees. It often occurs in the neck, back or gluteal regions. In the acute stages the pain is severe and the least movement causes great discomfort. The affected muscles are tender to pressure, and they may become contracted and rigid.

If the condition becomes chronic, aching continues and sometimes neuralgia develops.

**Muscular Torticollis or Stiff Neck.** The sternomastoid and other neck muscles are affected.

It is generally caused by cold or chill, or a sudden wrench.

The head is held stiffly as all movements cause pain. The affected muscles are tender to pressure.

*Treatment.* The patient must be placed in the most comfortable position possible, lying or sitting with the head supported.

Heat is applied, and very soothing massage is given. Much effleurage, then gentle kneading.

This condition generally responds quickly to treatment, and as the pain decreases, more massage can be given and active head and neck movements.

**Pleurodynia.** Rheumatism in the muscles of the chest wall. The pain is generally one-sided, and it is felt with each respiratory act. Probably a particular intercostal space is the seat of tenderness, or the origin of the Pectoral or Serrati muscles.

*Treatment.* The movement of the corresponding ribs is fixed by a plaster or bandage, and later massage may be given as for intercostal neuralgia (p. 379).

**Lumbago.** When the inflammatory condition of muscle and fascia occurs in the lumbar region of the back, it is called lumbago.

Severe pain and stiffness may come on very suddenly, a patient finds himself unable to bend forwards or to straighten the back. Turning in bed may become impossible.

There may be layers or plaques of thickening—spasm in the muscles, and nodules which are painful and tender to pressure. The condition may be due to chill or strain, though it is not always possible to trace a cause.

*Treatment.* In the acute stage is rest and hot applications such as radiant heat, or infra-red ; diathermy or hot mud packs.

Massage is begun when the patient can bear it. The prone position should be taken if possible, otherwise side-lying, and it is essential that the affected part should be as relaxed as much as possible.

The massage should include effleurage, kneading, frictions, vibrations, beginning mildly, but eventually the manipulations must be deep. Any painful spots need special attention.

Later, tapotement may be added and active exercises should be encouraged as soon as possible.

Gentle free trunk movements may begin as soon as the acute stage has passed.

The following is a useful exercise. Long-sitting, the gymnast grasps the patient's hands and allows him to sink back on the pillows giving resistance. The gymnast draws him to sitting, the patient resisting.

**Fibrositis of the Head.** Fibrositis may affect the scalp, giving rise to a dull aching headache. There may be a tenderness of the eyeballs.

Thickenings and tender nodules may be felt in the scalp, neck and shoulder muscles. There may be pain in the branches of the trigeminal nerve and in the occipital nerves.

*Treatment.* Radiant heat and massage are given. The position of the patient must insure relaxation of the parts treated.

For the neck. The patient sits resting his head on his arms (see p. 37). Effleurage, deep kneading, friction, picking up and tapotement are given.

For the head. The physiotherapist stands beside the patient and supports the head as much as possible. Much friction to the scalp is used (see p. 46).

Face massage may be added if necessary (see p. 45). Aim at improving the circulation by effleurage and gentle finger kneading. Vibrations may also be given on the nerves.

Free movements to the head are finally added in reach grasp sitting position. Head rolling, side-bending and turning.

## ARTICULAR RHEUMATISM

### RHEUMATOID ARTHRITIS

Rheumatoid arthritis is a disease mainly characterised by inflammatory changes in the joints which lead to deformity, While the disease may be found in both sexes, it is commonest in women. The condition begins with fever and swollen, painful joints. The smaller joints are usually affected first, especially those of the fingers. The changes usually occur on both sides of the body, and the trouble gradually extends to the larger joints.

There is considerable doubt as to the cause of this condition. It may be the result of acute disease. Sometimes there is a hereditary tendency. Cold and damp are predisposing causes, it may follow some exhausting illness, mental strain or childbirth, or an occupation may be a cause.

Before the joints become affected there is often a stage of painful cramps, numbness, and tingling in the hands.

Then the following signs and symptoms appear :—

The small joints of the hands are first involved. There are changes in the fibrous capsule surrounding the joints, giving rise to swollen fingers which become spindle-shaped. The interosseous muscles waste. The wrists swell and there is deviation of the hand towards the ulnar side. There is spasm in the muscles, around wrists, shoulders and ankles, also in the neck region. Some muscle groups waste, especially those of the forearm and quadriceps. Often there is stiffness in feet and ankles, and the knees may become swollen. The hands and feet are moist and cold in the early active stages of the disease. Deformities eventually occur in varied degrees unless steps are taken to prevent them. There are symptoms of general ill-health, in fact it is considered to be a disease of the whole body, rather than of joints alone, whereas in osteo-arthritis the opposite is the case.

When first examined a focal sepsis is often found, especially in the teeth and tonsils, but it may also be present in other parts of the body. Sometimes the disease starts after an injury, or it may occur after a strong emotional disturbance. Anæmia, digestive and heart symptoms may appear.

*Treatment.* This is medical. After any sepsis has been dealt with, the physician may order gold injections, or special vaccines, also injected.

The patient should be warmly clothed and sometimes individual joints must be wrapped in wool. When possible the most suitable climate must be chosen for the patient to live in.

*In the acute stage* the patient's joints must rest, and be kept in corrected positions to prevent deformities. This is done by moulded plaster supports. During this period the patient is taught to contract and relax the muscles acting on the affected joints, without doing movements.

Some doctors advise that the joints should be moved once daily to prevent stiffness.

*In the sub-acute stage* more treatment is added.

Massage of the muscles, active assisted movements within the limit of pain. All beginning gently and gradually increasing, getting as full a range as possible.

The physiotherapist must discover the best way of carrying out the movements in an individual case, and they should be done daily. Eventually every joint in the body is moved 4 to 8 times during treatment.

The exercises should first be done lying, but later in sitting, standing and walking.

Attention must be paid to good posture, the patient must not be over-tired, she should be urged to take an interest in her treatment, and given encouragement as she progresses.

Various forms of electro-therapy are also much used in this condition. Radiant heat, infra-red, ionisation and diathermy to the joints. Faradism to the muscles. Hydrotherapy is also of great value, including massage under water, hot air and whirlpool baths, various douches, brine baths and hot mud packs.

### OSTEO-ARTHRITIS

This form of the disease usually attacks much older patients. The larger joints, especially knees and hips, are involved, though frequently one joint only is affected.

The condition may be due to lowered vitality, exposure to wet and cold, but it is often the result of injury (traumatic).

*Signs and Symptoms.* In the early stages some inflammation in the structures around the joint is present. There is pain, swelling, limited movement and wasting of muscles.

Then, if the disease progresses, changes take place in the joint. The articular cartilage is gradually worn away, and the bone surfaces touch each other. There may be lipping of the cartilages and fringing of synovial membranes. Outgrowths known as osteophytes are frequently present. They sometimes break off and form loose bodies in the joint.

*Treatment.* X-rays are taken, and if treatment is begun before the X-ray films show bony changes, much can be done for the patient.

Rest and some form of heat is first given to reduce the inflammatory condition. When this has subsided somewhat, further treatment is added.

Massage of the muscles to improve their strength and tone, to arrest wasting, and to stretch contracted muscles and ligaments.

Effleurage, kneading and frictions may be applied to the joint itself, but if bony changes have occurred in the joint, deep frictions should be omitted.

Muscle contractions are taught.

Active movements are added.

The patient is encouraged to do the movements, whether painful or not. These should first be done with assistance, or with the limb supported in a sling.

Electro- and hydrotherapy are also used following the same lines as for rheumatoid arthritis.

In the later stages the surgeon may have to remove osteophytes which have formed loose bodies in the joint, or it may be desirable to fix a joint in order to relieve pain ; arthrodesis is then performed.

In some cases a caliper is applied for the hip-joint, or a knee cage for the knee to reduce strain on the affected joint.

### INFECTIVE ARTHRITIS

This may be due to some general disease, or a definite focus of infection may be found in teeth, tonsils, nasal sinuses, antrum, intestinal tract or genito-urinary organs.

Attention to, and removal of, any such condition generally leads to cure or alleviation of the joint trouble.

One or two of the larger joints may, however, become seriously affected.

The condition varies from a mild synovitis to an intense arthritis of the whole joint.

*Signs and Symptoms.* These vary in severity. They may be the same as in traumatic arthritis, or there may be acute inflammation with intense pain, muscle spasm and loss of movement. Such a condition may end in a complete ankylosis of the joint.

*Treatment.* Only the milder forms are suitable for physical treatment, and this is carried out on the same lines as already described for traumatic osteo-arthritis.

### CLIMACTERIC ARTHRITIS

This is a form of arthritis common among women at the change of life. The knees are the joints usually affected, and the condition is associated with overweight and panniculitis.

*Treatment.* This must be both general and local. The diet should be regulated, as it is often essential to reduce the patient's weight.

The treatment of the panniculitis and the actual joint condition may follow the lines already described.

## GOUT

Gout is a constitutional disease in which undue proportions of uric acid are present in the blood. The name is derived from " gutta, a drop," on account of an ancient idea of the dropping of a morbid fluid into the joints.

The condition is one of perverted metabolism. There is imperfect elimination of the toxic products in the blood, excess of uric acid, and there are deposits of biurate of sodium in the joints and other structures.

The disease is generally characterised by an inflammation of the joints, the smaller ones being attacked first, specially the metatarso-phalangeal joint of the great toe. There are other general symptoms.

Gout occurs in acute attacks which are recurring, or it may become a chronic condition. The gouty diathesis is also spoken of, which means a constitutional predisposition towards the disease. It is more common in men than in women, and usually first appears between the ages of thirty-five and forty.

Gout is due to: (*a*) hereditary transmission; (*b*) errors in diet; (*c*) the influence of lead upon the system.

An attack may come without any exciting cause, but it is often due to: exposure to wet and cold, injudicious eating and drinking, worry, anxiety, injury, after acute illness, etc.

*An Acute Attack.* The patient is usually aroused from sleep in the night, with much pain in the great toe. Tenderness of the affected joint is very marked; the patient dreads to be touched or moved, and cannot even bear the weight of the bedclothes. The joint is hot, swollen, deep red in colour, and the skin shiny and tense. There are general symptoms, *e.g.* raised temperature, acid perspirations, loss of appetite, furred tongue, constipation, changes in the urine. The patient is restless and irritable. The attack lasts from three to four days to two to three weeks. As the acute symptoms diminish, there is often œdema of the surrounding parts of the affected joints, which pit on pressure, and this condition may remain for some time.

At first the treatment is entirely medical, but when acute symptoms have subsided, gentle massage and movements may begin to reduce œdema, restore movement, and improve the general condition. Later, general massage may be of great benefit.

## CHRONIC GOUT

This is generally the result of acute attacks, and gradually more and more joints become affected. The articulations become enlarged, deformed, stiff, and crippled in movement. Chalky concretions are laid down. These sometimes may become so enlarged that they break through the skin, and come away in solid particles, or in liquid form. Such concretions are called chalk-stones. The general system is more or less affected with disorders of digestion, respiration, skin and kidney diseases, etc.

*Treatment.* People possessing the gouty diathesis, by careful attention to their ways of living, may ward off the disease. Suitable food should be taken, and the stomach never over-loaded. Attention to general hygiene is important, *e.g.* fresh air and regular exercise. Chills, worry, anxiety, etc., should be avoided.

The diet must be carefully regulated.

Massage must aim at improving the circulation and digestion, and in helping elimination. Local massage and movements may be given to affected joints, but the treatment must continue for long, and the result is often unsatisfactory.

Electrical treatment is given on the same lines as for rheumatoid arthritis.

### SPONDYLITIS

Spondylitis is arthritis of the spine.

**Spondylitis deformans** is one form which progresses slowly, and usually occurs in men whose occupation has thrown a strain on the back, *e.g.*, railway porters, gardeners and miners.

The patient complains of increasing stiffness and pain, and he has a characteristic stoop. There may be fibrositis of the muscles and ligaments.

*Physical treatment* may give considerable relief. Some form of heat, *e.g.*, diathermy, and hydrotherapy is helpful. Massage and graduated exercises to strengthen muscles and maintain mobility should be added.

**Ankylosing spondylitis** is a more serious condition. It is nearly always caused by an infective arthritis. There are changes beginning in the sacro-iliac region and spreading to other joints of the spine, and often extending to shoulders, neck and hips (occasionally to knees). The thorax, too, may become immovable. There is pain and muscular wasting.

*Treatment.* Breathing, stressing thoracic movement, must be practised continually. Some form of heat is helpful in relieving pain, *e.g.*, short-wave therapy.

Gentle massage is given to improve circulation, and the patient is urged to do small active movements.

Sling and pulley exercises when the apparatus is available have been found helpful, though treatment by this means needs much care and special work, both for physiotherapist and patient.

Deep X-ray therapy is also used for these cases.

# CHAPTER XXIV

Myopathy—Polyuria or Diabetes Insipidus—Diabetes Mellitus—Rickets—Obesity—Anæmia.

## MYOPATHY

MYOPATHY is a condition in which atrophy of some muscle-groups occur, while enlargement of others takes place. The latter is described as pseudo-hypertrophy, for it is not due to increase in size of the muscle fibres but rather to deposits of fat and fibrous tissue. Sometimes enlargement of the muscles is the most strongly marked, in others atrophy is more prominent. This disease is an hereditary one. Several members of a family may be attacked, and it is sometimes traced through several generations. It shows itself in early life, few cases beginning after the twentieth year.

*Symptoms.* The child gradually becomes clumsy in his or her movements and falls about.

Muscles which usually become enlarged are: Those of the calf, the extensors of the knee, specially vastus externus, and gluteus maximus. Deltoid, supra and infra spinati, and triceps. Erector spinæ is enlarged in some cases, atrophied in others.

Muscles which atrophy are: The lower half of pectoralis major, and latissimus dorsi; biceps and sometimes serratus magnus. The flexors of the knee, and the adductors and flexors of the hip.

All the affected muscles are weak, and deformities of the spine frequently appear. The patient has difficulty in rising from a recumbent position.

*Treatment.* The disease is incurable, but the patient's general health must be maintained.

The atrophied muscles must be massaged, and galvanism is useful. By the aid of such means the muscles gain nutrition, and progress of the atrophy may be arrested. Movements should be given to stretch and prevent contractures.

## POLYURIA OR DIABETES INSIPIDUS

"A malady characterised by thirst, and a persistent excessive flow of watery urine, which has a low specific gravity, and contains neither albumen nor sugar" (*Harold*).

This disease is often connected with nervous affections, and it is usually hereditary. Usually the bowels are confined and the skin dry.

*Treatment.* This should include much rest and a nourishing diet. The patient should be warmly clothed, and guarded against chills. Change of air and scene is often necessary.

Massage, when ordered, should be general, and easy exercises may be added.

## DIABETES MELLITUS

Diabetes mellitus is a disease of disordered metabolism. It is characterised by the presence of grape-sugar in the urine. It may occur at any age, and is more common in men than in women.

The following are some of the causes: an hereditary predisposition, exposure to cold, gout, mental emotion, and a diet containing too much carbohydrate.

If young people are attacked, the disease takes an acute form, there is rapid wasting, and death ensues. If it occurs in elderly people, they remain well nourished, and the disease is not usually fatal.

*Symptoms.* These vary according to the severity of the disease, the age of the patient, etc. There is an excessive flow of urine containing sugar. Thirst, wasting, and muscle weakness are present. Complications occur, a characteristic one being "diabetic coma," *i.e.* the patient becomes deeply unconscious, and this condition generally ends in death.

*Treatment.* Drugs are given, but diet is very important and needs careful regulation.

If massage is ordered, it should aim at helping the general nutrition by effleurage and muscle kneading, and improving the digestive processes by careful abdominal manipulations.

## RICKETS

Rickets is a general disease of malnutrition occurring in children. The natural growth and development of the body is arrested, ossification and dentition are delayed, the bones become soft and yield to pressure, and the muscles and ligaments waste. In many cases there are alterations in the brain, liver, spleen, and lymphatic glands.

The greatest factor in producing rickets is improper food, specially the giving of much starchy food to the young child. Other causes are uncleanliness, want of fresh air, sunlight, and sufficient exercise.

*Early General Symptoms.* The child may be flabby and fat or thin. The digestion is disturbed, and vomiting and diarrhœa are often present. The mucous membrane is pale, the spleen is enlarged, and the whole abdomen protrudes. There is profuse sweating of the head, face, and neck. The child is irritable and restless, and throws off the bedclothes when sleeping.

*Bony Changes.* Owing to the retarded growth and softness of bones many changes occur, producing deformities.

The head becomes flattened from back to front, the forehead appears square in shape and enlarges. Ossification of the cranial bones is very slow, and the fontanelles remain open much longer than usual (after the end of the second year).

The teeth are late in appearing, stunted in growth and defective in enamel, and often quickly decay. The shafts of the long bones, when softened, bend in various directions ; there is abnormal development of the epiphyses.

The spine may become kyphotic. This occurs when the child is allowed to lie much in bed with a high pillow, or is carried about with a curved back. Sometimes scoliosis appears ; when a child is carried on the nurse's arm, a bad position is often assumed, the pelvis is tilted, and the spine curves laterally.

There are characteristic changes in the thorax. The " rickety rosary " is a bead-like formation on each side of the sternum, at the junction of the ribs with the costal cartilages. It is due to the enlargement of the ends of the ribs. " Pigeon breast " is a condition in which the sternum is pressed forwards, causing the thorax to be enlarged from back to front, and the curvature of the ribs at their angles is increased.

The prominence of the abdomen is due to the enlargement of the viscera, and distension by flatulence. The linea alba is often widened. A child with such an abdomen is often described as " pot-bellied."

The shape of the pelvis is often considerably altered. It becomes triangular, and sometimes very narrowed. It is pressed upon by the spine and abdominal contents from above, and by the heads of the thigh bones from below. Later in life, the effects of such a deformity upon parturition may be very serious.

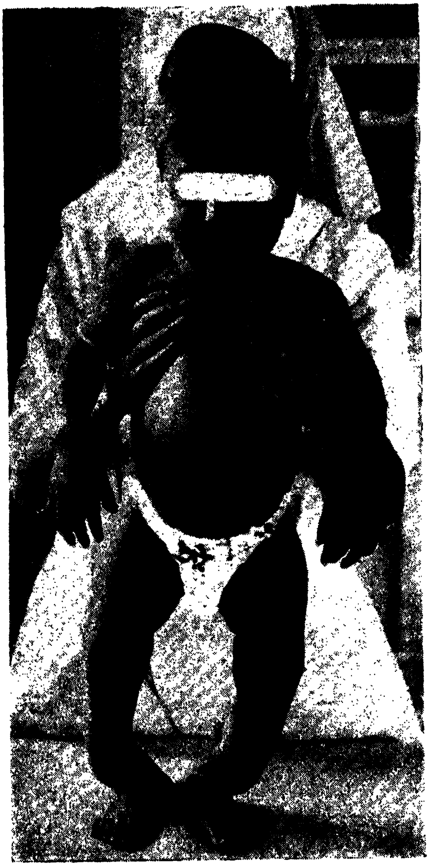

FIG. 131.—RICKETS. BOY OF FOUR YEARS, SHOWING CURVED BONES, ENLARGED ABDOMEN AND WRISTS.

Scoliosis, kyphosis, coxa vara, knock knees, bow legs, and flat foot, all of which may occur as the result of rickets, are dealt with in detail in Chapter XXI.

*Treatment.* General hygienic conditions and diet must be corrected. The living-rooms should be well ventilated, and the child taken out regularly into the open air. He must be warmly clad, and his daily bath given quickly to avoid chills.

The diet should consist chiefly of good cow's milk, diluted if necessary with lime water. The following may also be added—the juice of raw beef, other prepared meat-juices, broth, bread-and-butter, the yolk of an egg, etc. Later a small amount of farinaceous food may be given. Food digestible to one child is indigestible to another, therefore the diet must be regulated with the greatest care. The mother should understand that the child's recovery depends upon her watchfulness and care.

Deformities must be prevented as far as possible. The child is kept in the recumbent position, but the limbs should have freedom; plenty of kicking is good without weight-bearing. He must not therefore crawl or run about.

Sometimes a rickety child lies in a wicker tray, while others sleep in a specially moulded plaster bed. If the legs show evidence of bowing, weight bearing has probably been allowed while the bones are still soft. This may be remedied by wearing light well-padded splints, which project below the feet.

When further deformities have occurred, they are corrected surgically and plaster of Paris is applied. After removal of the plaster, massage to the limbs may be ordered, and later active movements and re-education in walking are given.

Deep breathing should be taught and practised daily, and easy exercises may be added.

Ultra violet sunlight is of great value in the treatment of rickets, and should be combined with the methods already described.

## OBESITY

Obesity is produced when an excessive amount of adipose tissue is developed in different parts of the body.

The condition may be hereditary, but there are several other factors to be considered.

*An alimentary type* caused by an excess of food, and too little exercise. In middle life both men and women begin to lead a less active life, and yet may continue to take the same amount of food as before.

*An endocrinal type* caused by disturbance of the endocrine glands, *i.e.* the thyroid and pituitary.

In either case there are metabolic changes, and the intake of the body becomes greater than the output. The carbohydrates and fats are not sufficiently oxidised.

The condition may be associated with disturbances of menstruation and pregnancy, and it frequently manifests itself during the menopause.

Obesity seems to vary in different races and climates. Among the ancient Greeks and Romans it was considered a disgrace, while among certain castes of Hindoos it has been highly esteemed. Fat people are met with in all climates, but they are seen less in hot and mountainous districts. Sedentary occupations undoubtedly favour corpulency in both sexes; this may be increased by excessive eating, and the taking of alcohol.

*Food.* Although taking a large quantity of food may cause a person to become fat, it does not always do so, for very thin people are often large eaters, and some who become fat have poor appetites. Neither does the kind of food taken always make a difference. Some will get fat whatever they eat, and others remain thin in spite of much nourishing food.

The fatty tissues must be derived from the fat, starch, and proteids of the food taken. But the fact that they are stored in the body as adipose tissue shows that the chemical processes are not complete, oxidation is delayed, or these substances would be converted into carbonic acid and water and eliminated from the body.

Fat is often deposited in large quantities in the subcutaneous tissues; the areas usually chosen are the abdomen, the buttocks, the neck, and breasts. It is often present in excess within the great omentum, *i.e.* the apron-like fold of peritoneum extending over the organs from the lower border of the stomach. The usual weight of the omentum is ½ lb., it may increase to 7 or 8 lb. in the obese.

Fat is also deposited beneath serous membranes, so is sometimes largely present in joints. The muscular tissues often become infiltrated with fat. Certain organs, chiefly the liver and heart, become enlarged, and fat is deposited within their tissues.

*Treatment.* The diet must be regulated in quantity and quality. There are various systems of dietary for the corpulent. (Under no circumstances should a patient try to become thin by a process of self-inflicted starvation.) The diet should always be regulated by the doctor, who orders as a rule a withdrawal of fatty and starchy foods, and some increase of proteids.

" The weekly loss of weight should not exceed 3 lb., and the total loss not go beyond 28 lb." (*Allchin*).

Regular exercise must be taken according to the patient's powers ; riding, walking, etc.

*Massage and Exercises.* Combined with the special diet which must be strictly carried out, some physical treatment is of great benefit. Massage alone will not serve a useful purpose, but when given as well as active exercises, it is a help.

Kneading and petrissage of the fat masses should be done vigorously and as deeply as possible. A large movement may be employed on the abdomen, grasping the fat with both hands, and wringing it backwards and forwards.

Strong tapotement may be used over the back and gluteal regions.

Breathing exercises should be much used as there is an increased need for oxygen to help in the metabolic processes. The patient should be taught deep breathing, and it should be done 4 to 6 times during a treatment, as well as morning and evening.

Active exercises must be vigorous, but not too numerous. A table should be written by the gymnast. It should include massage of the fat masses, and exercises such as :—

Breathing ; apical, costal, and diaphragmatic.

Free arm flexions and extensions in all directions. Arm swinging. Leg rolling, flexion and extension and leg swinging. Heel raising and knee bending and alternate knee lifting, with upward jerk. Hewing and sawing. Head and neck movements. Wing stretch stride standing, downward and forward bending. Trunk rolling and alternate trunk turning and bending. Abdominal contractions.

Among other exercises, Hornibrook advises the following :—

*Hammock Swing.* The patient lies in crook position, hands in pronation. The pelvis is raised 2 inches from the ground, then it is twisted vigorously from side to side. 4 to 20 times ; rest and repeat 3 to 6 times.

*Wing stride standing, trunk flexion sideways* to right. 3 to 6 sharp bendings. Repeat to left.

*Contraction and relaxation* of abdominal walls. This can be done in any position and at any time.

## ANÆMIA

Anæmia is a condition in which there are changes in the blood.

It is classed as **primary** and **secondary.**

### PERNICIOUS ANÆMIA (PRIMARY)

This is a grave condition affecting people of both sexes in middle life.

Formerly it was supposed to be due to some defective function of the liver, but in recent years the cause is considered to be a deficiency in the secretions of the mucous membrane of the stomach.

The manufacture of the red corpuscles in the blood is also diminished, and though the hæmoglobin is increased in the cells themselves, the body does not receive enough oxygen.

The patient suffers from extreme debility. There is weakness and fatty degeneration of the heart. Gastric symptoms also, *e.g.*, loss of appetite, diarrhœa, vomiting, etc. Nervous symptoms may appear resulting in spasm or a flaccid condition of the muscles.

*Treatment.* This is medical, but rest and good food are necessary. Treatment of the liver and stomach are important. Liver is taken as food, as it replaces deficiencies in the stomach.

*Physical Treatment.* This may be ordered, and general massage is given progressing to easy exercises. Progress is generally slow. Breathing exercises should help the intake of oxygen. Any condition of spasm or flaccidity must be dealt with according to the lesion which presents itself.

All other forms of anæmia are *secondary*. These may appear as the result of some other disease or condition, *e.g.*, hæmorrhage, starvation or faulty hygiene. Want of light and exercise. The effects of some poisons, such as lead, mercury and malaria. Certain affections of the alimentary tract. Changes in the circulation caused by valvular disease or dilatation of the heart. It may be the result of syphilis, tuberculosis, bleeding from piles, excessive menstruation, etc.

*Chlorosis*, a form of anæmia in girls and young women, but is now rarely seen.

The whole process of metabolism and nutrition is impaired. The amount of hæmoglobin in the red blood cells is diminished, resulting in a reduced supply of oxygen and iron to the tissues.

*Symptoms.* General debility, paleness of skin and mucous membrane, cold extremities, muscular weakness, shortness of breath with any exertion, dyspepsia, and constipation, headache, giddiness and restless sleep. Disorders of menstruation.

*Treatment.* Improve the general condition by attention to surroundings. Sunshine, fresh air, moderate exercise and rest are necessary. Diet must be regulated. Iron tonics are usually given.

*Physical Treatment.* Its aim is to increase the intake of oxygen, strengthen the muscular system, improve the circulation, digestion, and nervous systems.

Rest is important, and must be regulated according to the patient's condition.

General massage, breathing exercises are given, and active movements in all joints are added.

Later a gymnastic table is written including breathing, trunk and extremity exercises done freely or with graduated resistance.

*Note.* Abdominal kneading is said to bring about an increase of red corpuscles in the blood.

# CHAPTER XXV

RESPIRATORY DISEASES :—Chronic Bronchitis—Emphysema—Principles in treating one-sided lung conditions—Pre- and post-operation cases—Bronchiectasis—After pneumonia—Pleurisy—Empyema—Asthma—Adenoids.

## RESPIRATORY DISEASES

THE student is referred to books on nursing for the history and treatment of such diseases as acute bronchitis, pneumonia, and pleurisy. During the convalescence of these conditions, or when bronchitis becomes chronic, massage and specialised breathing and other exercises may be of great benefit. Also after the removal of adenoids, it is necessary to establish a good habit of breathing and improve the patient's condition generally.

## CHRONIC BRONCHITIS

Chronic bronchitis is a chronic inflammation of the bronchial tubes. It is often the result of repeated acute attacks, but may arise from other causes. The symptoms vary in different cases, but some of the following are present: cough, expectoration, pain, soreness and uneasiness behind the sternum, and dyspnœa (difficult or laboured breathing). The condition is often accompanied by emphysema (dilatation of the alveoli of the lungs). There is always a danger of the chronic form becoming acute, especially among the aged.

*Treatment.* Attention must be paid to the general constitutional condition of the patient. It is also necessary to: (*a*) improve the breathing capacity ; (*b*) to loosen mucus and help expectoration ; (*c*) to increase mobility of the thorax ; and (*d*) to relieve constipation.

While the patient is still in bed, general massage is often given including abdominal kneading, but attention must be paid to breathing. Relaxation is first taught (p. 397). Then deep breathing to increase both inspiration and expiration

(p. 146). To loosen mucus and help expectoration, gentle chest clapping is given, also vibrations and shakings of the thorax. For this the patient lies first on one side then on the other.

When the patient gets up the exercises are continued and increased.

The practice of lower chest breathing is carried on as well as movements to increase mobility and circulation.

Gentle active exercises are given for back and neck and abdominal muscles, also free extremity movements, *e.g.*, arm and leg swinging.

Chest clapping (p. 148) is also useful.

## EMPHYSEMA

In emphysema the elasticity of the lung tissue is diminished, and the alveoli become distended. The condition causes expiration to be incomplete. Coughing helps to produce emphysema, so it is caused by other diseases such as bronchitis. Also it is seen in people who play wind instruments.

There is over-distension of the chest, which becomes more or less fixed in the position of inspiration. The thorax becomes barrel-shaped.

*Symptoms.* Dyspnœa appears in the early stages, and upon any exertion.

Inspiration is quick and short, expiration prolonged. Cyanosis is generally present owing to circulatory changes, and other heart symptoms often occur. The patient is weak and easily tired.

Indigestion and constipation are frequently present.

*Treatment.* The patient should live in a warm dry climate, and should have an easily digested diet.

*Physical Treatment* is important and aims at :—

(*a*) Relaxation.
(*b*) Mobilising the thorax and improving posture.
(*c*) Especially helping expiration.
(*d*) Improving the exchange of gases in the lungs.
(*e*) Relieving digestive symptoms.

Exercises may be given on the same lines as for bronchitis, paying special attention to expiration and diminishing the size of the thorax.

## PRINCIPLES FOR TREATING ONE-SIDED LUNG CONDITIONS

## PHYSICAL TREATMENT IN PRE- AND POST-OPERATION CASES

### Pre-operative Physical Treatment

This is used in cases of bronchiectasis, lung abscess, empyema, growths and other conditions which may demand surgery.

Relaxation, special breathing, limbering up and strengthening exercises. Easy movements for the chest, spine and arms These should be learnt prior to operation if possible, so that the patient is not worried by new and difficult instructions in the immediate post-operation period.

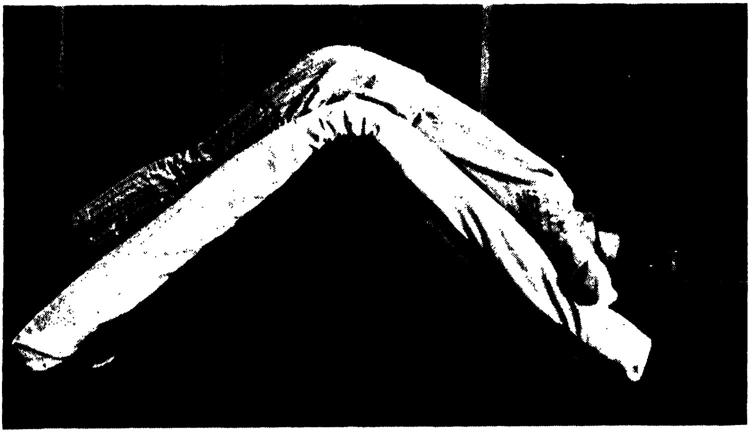

FIG. 132,—DEEP TIPPING POSITION. POSTURAL DRAINAGE FOR POSTERIOR BASAL AREA. THE BODY AT AN ANGLE OF 45°. POSITION IS MAINTAINED FROM 30 TO 60 MINUTES. BEGINNING AT 10 MINUTES

*From a photograph lent by Miss Linton and Miss Reed.*

When the patient is coughing up purulent sputum as in bronchiectasis or lung abscess the help of gravity is invoked by teaching the patient postural drainage or " tipping." The attitude the patient must adopt depends on the position of the pus-forming area in the lung.

The postural drainage is not a question of a few minutes each day, it must be maintained for several hours daily. The unusual position may be found trying at first, but the patient becomes accustomed to it.

The bases of the lungs are most commonly affected, and for this the " deep tipping " position is required.

The patient lies forward over the side of a bed, or on a special support, at an angle of about 45 degrees.

If the right middle lobe is to be drained, the patient lies on his back, but turned slightly to the left, with the foot of the bed raised 12 inches from the ground.

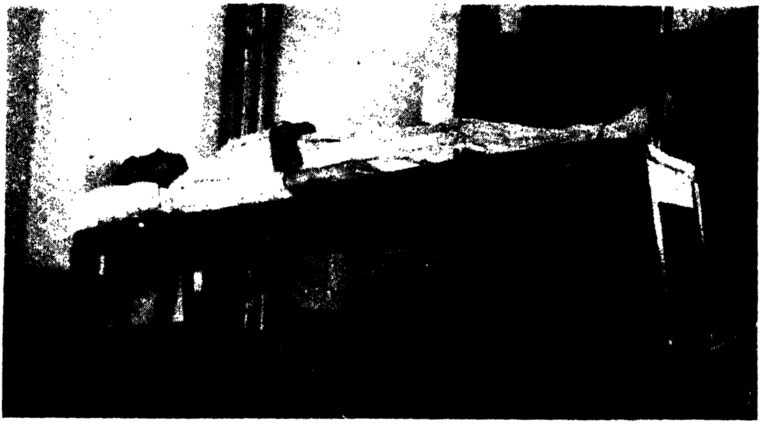

FIG. 133.—POSITION FOR DRAINAGE OF LEFT LINGULAR AREA, RIGHT MIDDLE LOBE DRAINAGE POSITION SIMILAR EXCEPT BODY ROTATED TO LEFT.

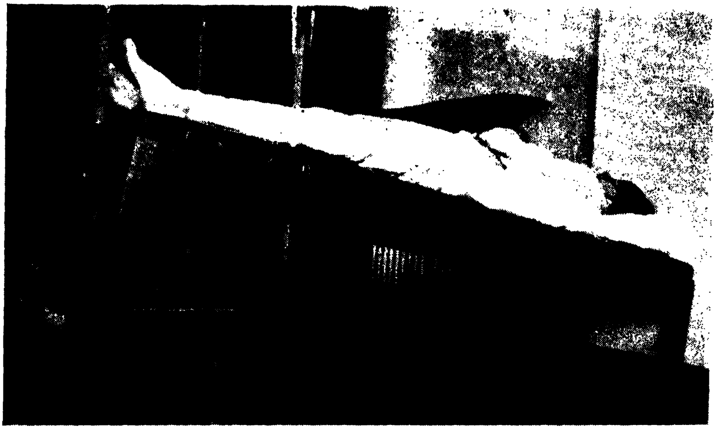

FIG. 134.—POSITION ALSO FOR DRAINAGE OF LEFT LINGULAR AREA, BUT SHOWING PATIENT ROTATED TO RIGHT BY PILLOW RAISING LEFT SIDE FROM HIP TO SHOULDER.

*From photographs lent by Miss Linton and Miss Reed.*

For the corresponding area on the left side of the chest (known as the lingular process) the same position is required, (see Figs. 133, 134), but the body is turned slightly to the right. Lying on one side will drain the lower part of the upper lobe on the opposite side.

Prone lying may be used if the back of the lung is affected, the patient lying over a pillow if necessary.

It is good to give tapôtement in the postural attitude, it helps to dislodge adherent mucus and improves drainage. No clapping, only vibrations are used in lung abscess conditions, or if bleeding has occurred. Belt pressure may also be used (see Figs. 136, 137).

## Special Localised Breathing

| | |
|---|---|
| Diaphragmatic. | With upper chest controlled (as for asthma, p. 318). |
| Lateral basal. | Patient learns to apply pressure placing hand well up on the side of the ribs. Done in time with breathing. |
| Upper lateral costal. | Pressure given on side, below axilla. |
| Pecto-apical. | The patient applies pressure with hand of opposite side, high over pectoral region. |

The right amount of pressure must be discovered for each patient. It is applied before inspiration begins, and maintained during expansion and relaxed during expiration.

## Post-operative Physical Treatment

This is important in empyema, lung abscess and lobectomy. Postural correction is necessary with arrangement of pillows to prevent faulty position and scoliosis. Mirrors can be used to show the patient what to do and to avoid.

Treatment may start 24 to 48 hours after an empyema has been drained.

Relaxation and massage over groups of muscles which may be held rigid, *e.g.*, back and shoulders.

Breathing. The physiotherapist places her hand lightly over the affected area, urging the patient to push out her hand as he breathes. She supports the chest with the opposite hand.

Assisted active movements are given for the arm.

*Later.* Active movements in all the joints, and eventually a mild scheme of exercises is given.

*Note.* While the patient is in hospital it is important that the physiotherapist and nurse collaborate, so that they instruct the patient on the same lines.

### BRONCHIECTASIS

This is generally a condition occurring as a sequel to some other lung disease, *e.g.*, chronic bronchitis, broncho-pneumonia, etc. The muscular walls of the bronchi have become weakened, they dilate and sacs are formed. Secretions of the mucous membrane collect in the sacs, remain there and decompose. The patient has a troublesome cough, and as a rule there is copious and sometimes offensive expectoration.

*Treatment.* Inhalations are given to disinfect the cavities, and sometimes a surgical operation is done to remove diseased parts of the lung.

*Physical Treatment.* This is the same as that described for pre-operation cases (p. 310). Postural drainage is important, and chest clapping in the postural attitude is useful.

Breathing. (*a*) Diaphragmatic, both sides.
(*b*) All areas on affected side.

### TREATMENT OF CONVALESCENTS AFTER PNEUMONIA

In the acute stage medical treatment and good nursing are essential.

Diathermy is ordered in some cases and found very useful, but should only be given under the express direction of the doctor.

Many patients make a good recovery, but some who only regain strength slowly are much helped by physical treatment.

*The aims are :* To strengthen the patient, and improve his general health.

To cautiously expand the affected lung.

To help the patient maintain a good posture.

*Treatment.* The patient still in bed half-lying, but well propped up with pillows.

Special breathing to expand the lung which has been affected.

Sometimes massage is given to back and chest. Movements should include kneading, vibrations, light hacking and clapping.

Later, active movements in all joints added.

When the patient gets up a graduated scheme of exercises is given.

### PLEURISY

Pleurisy is an inflammation of the pleural membranes. The disease may be caused by—a lowered vitality, damp or chill, rheumatism, and tubercle.

There are two varieties :—

Dry pleurisy. Little exudation is present.

Pleurisy with effusion. There is much exudation into the pleural cavity. This may progress to a condition known as empyema, when the exuded fluid becomes infected and turns to pus.

In dry pleurisy there is sharp pain in the side and breathing is difficult, and a slight temperature.

When effusion is present there is no pain, but a higher temperature, and breathing is more difficult.

*Treatment.* Complete rest in bed, and good nursing is essential.

In dry pleurisy strapping is applied to fix the chest and so relieve the pain. The strapping extends from the sternum to the spine, covering the painful area.

*Physical Treatment.* When the temperature is normal massage may be given to strengthen generally, but as the patient is probably very weak for not more than 15 minutes in conjunction with the graduated exercises.

Breathing is taught, specially localising on the affected side (see previous notes).

Later a general strengthening table is given, including double-sided breathing exercises, vibrations and shakings of the thorax, chest clapping, movements to increase mobility and to improve posture by graduated exercises for all parts of the body.

### EMPYEMA

This condition is a complication of pleurisy. The fluid which has been exuded into the pleural cavity becomes purulent. The patient has a high temperature and is seriously ill.

*Treatment.* This is surgical and consists of drainage. It is maintained at first by means of a tube passing into a bottle, and later by a short tube and dressing. When possible it is well to teach the patient what he is required to do before the operation, but 24 hours after, physical treatment should begin. The tube and dressing remain untouched.

The patient lies supported on pillows, keeping a straight position. The physiotherapist stands or sits at the patient's side, placing one hand on the lower chest, the other steadying the sound side. Diaphragmatic breathing is first done, later the mid-chest area is used, and lastly the pectero-apical.

It takes about a week to work up to all the areas.

Assisted and very soon resisted arm movements are given between the breathing, also small postural corrective movements.

Before the patient gets up leg exercises are done in bed.

Later, when up, trunk movements are gradually added.

The patient must not be overtired, and any rise in pulse or temperature noted and reported.

Great care is required to keep the wound aseptic. It is always covered and well bandaged during the treatment.

## ASTHMA

Asthma is a condition in which a patient experiences paroxysms of difficult breathing. It is caused by a narrowing of the small bronchi, which is the result of spasm in the muscular coat. There is also congestion of the mucous membrane of the bronchi and an increased secretion of mucus.

During the attacks of difficult breathing, inspiration is easier than expiration, therefore the lungs become more and more distended with air. At the height of an attack the lungs are distended to their fullest capacity, and each effort of expiration results in the expulsion of only a very small amount of air. At the end of an attack the extra air taken in is expelled, and the lungs return to their normal size. The condition is not the same as emphysema, when the lung tissue loses its elasticity.

In chronic asthma, the patient remains slightly out of breath and the lungs remain somewhat over-distended. When this is the case the thorax becomes (the so-called) barrel-shape and adapts itself to the condition of the lungs. The shoulders also are raised, there may be alterations in the spine, and the epigastric angle is widened. If this condition of the thorax continues, the muscles become altered, *i.e.* they assume a new postural length or tone.

Asthma occurs in people of all ages and both sexes.

There are several types. The *Bronchial*, brought on by bronchitis or emphysema.

In others the patient is hypersensitive to certain proteins in food, animal emanations, the pollen of flowers, dust, etc. He is said to be *allergic* to these things. This form may be inherited. The parents may have been subject to other allergic conditions such as eczema, hay fever or migraine. It is the hypersensitivity that is inherited.

In others reflex action brings on the asthma, as a result of a mechanical cause, such as a deflected nasal septum, a dilated stomach, infection of tonsils, appendix, etc.

*Treatment.* There are various remedies. Adrenalin is much used as it brings instant relief. It is given by injection or as an inhalation. Special vaccines are prepared and are also administered by injections.

*Physical Treatment.* Breathing exercises must be learnt and practised regularly between the attacks of asthma in a special way. Their object is to reduce the size of the thorax and to rest the upper part of the chest as much as possible. An asthmatic subject usually carries out the respiration with the upper part of the chest, the lower part remaining expanded and almost fixed, or it may be narrow and fixed. He must first learn relaxation and then practise diaphragmatic breathing. All the breathing begins and ends with expiration.

Exercises are also taught to mobilise the thorax, and others to correct any faulty posture which may have been acquired. It is essential that breathing exercises for asthma be given by a physiotherapist specially trained to teach them. When the patient understands what he or she has to do, " he " continues the exercises alone, and should practise them daily, even after the attacks have ceased.

Much depends on the personality and understanding of the physiotherapist, she must learn to know her patient, and his mental attitude counts for much.

There are certain occupations which tend to increase the tensing and overtone of muscles, *e.g.*, hard physical labour. This may be detrimental to an asthmatic. Another type is over-anxious and worried. Sometimes psychological treatment is required as well as physical, and many are helped by having a rest away from their home surroundings.

In any case the patient must learn confidence, and will be greatly encouraged on finding he can help to prevent an attack instead of depending on drugs, or help from an outside source.

### INSTRUCTIONS FOR SPECIAL DIAPHRAGMATIC BREATHING

*Positions. Crook half-lying, i.e.*, the knees are drawn up and head and shoulders comfortably supported on pillows.

*High side lying*, again knees drawn up, and head and shoulders supported on pillows. Shoulder-girdle well relaxed.

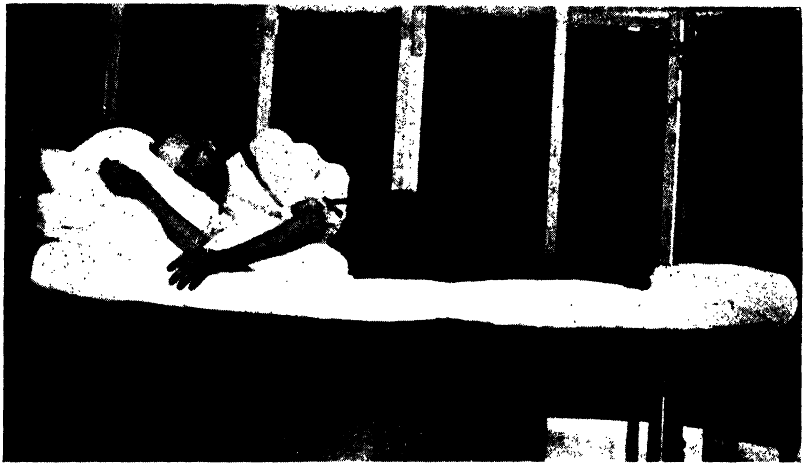

FIG. 135.—HIGH SIDE LYING. THE PATIENT IS SLIGHTLY ROTATED ONTO HIS FACE. THE UPPER LEG IS CARRIED IN FRONT OF THE UNDER ONE. A PILLOW IS PLACED UNDER THE PATIENT'S SIDE TO PREVENT THE SPINE FROM SAGGING. THE SHOULDER FITS BETWEEN THIS AND OTHER PILLOWS FOR THE HEAD THE UPPER ARM RESTS ON A PILLOW.

*From a photograph lent by Miss Linton and Miss Reed.*

*Sitting.*

*Standing.*

The patient must be warmly clad, but not restricted by clothing in any way.

The room should be warm (60°), but the air fresh. Draughts must be avoided.

The breathing should be done :—

(*a*) In the morning, before breakfast.

(*b*) At night, at bedtime.

(*c*) Whenever an attack is imminent.

Patients can learn to control their asthma by breathing in the special way.

Points to be noticed :—

1. Before breathing the patient should clear the nasal passages by using a handkerchief.

2. Breathing is done through the nose (mouth closed), breathing out through the mouth (lips parted).

3. The patient first empties the lungs as far as possible by *breathing out*, he then takes a short quiet *breathe in* through the nose, following this with a *long breathe out* through the mouth, making a slight hissing sound with lips and teeth.

There will probably be some wheezing at the base of the lungs, which may cause coughing, if this is the case after a rest, the gentle breathing must be continued.

When coughing occurs, side lying position is best.

4. *During the short inspiration* the upper part of the chest must be *kept quite still.* The inspiratory movement is performed chiefly by the diaphragm.

*During the long expiration* the abdominal wall should contract, *i.e., be drawn in towards the spine.* The next breath is taken in by allowing the abdominal wall to relax and the lower front ribs gently expand (round the waist). The patient's hands rest gently on the lower front ribs, so that the rib movement can be felt.

5. All exercises should *end with an expiration* and contraction of the abdominal wall.

6. A short pause is made after inspiration, but none after expiration.

7. The series is repeated 4 to 6 times. Always *four expirations to three inspirations.*

8. If the patient takes a gasping breath after expiration it shows that the *breathing out* was too long. He should be ready for a quiet intake without raising the chest. By degrees the expirations become longer and may be increased from 5 up to 10 or 15 seconds.

## Short Diaphragmatic Breathing

The following is another modification to be done when the patient's breathing is too short and difficult to carry out long expirations.

Relax the upper chest. Then during expiration contract the abdomen.

*Breathe in* and relax the abdomen quickly, following this by sharply contracting the abdomen with the next expiration. This is quicker than normal breathing and should be learnt at a time when the patient is as free from asthma as possible.

*Lateral costal breathing* may also be done to aerate one side of the chest and then the other. Later a double-sided movement is practised.

Either the same half-lying position is used or sitting with back supported.

(*a*) Breathe out, and give slight pressure.

(*b*) Breathe in and expand out against pressure.

(*c*) Breathe out and give pressure at the end of the expiration.

The series is repeated 4 to 6 times and then done on the opposite side.

It may also be done to right and left alternately.

## Breathing with Belt Pressure

*Position.* Sitting, supported by chair back.

This exercise is the same as the previous one, but the pressure is given by a belt.

The belt is placed round the lower ribs.

(*a*) *Breathe out,* first sinking the upper chest, then lower. Finally squeeze the ribs by tightening the belt, and in this way empty the lungs as much as possible.

(*b*) *Breathe in,* expanding the ribs (pushing out the belt). 4 to 6 times.

The belt may be used on one side only, *i.e.*, the patient fixes one side while allowing the opposite side to be pushed out during inspiration, and giving extra pressure by the belt at the end of expiration. This may be done 4 to 6 times and the same be repeated on the opposite side.

Some patients find it easier to give the pressure with their hands instead of using the belt.

*Forward bending and raising.*

*Position.* Sitting. Feet apart, arms hanging at sides, on a chair with back.

(*a*) *Breathe out* and drop the head forwards, round the back

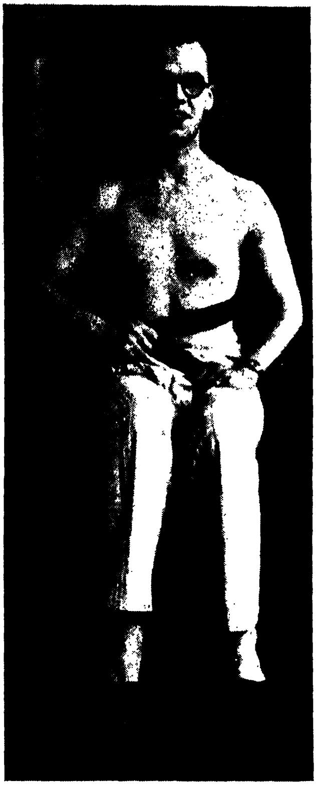

FIG. 136.—EXPIRATION.

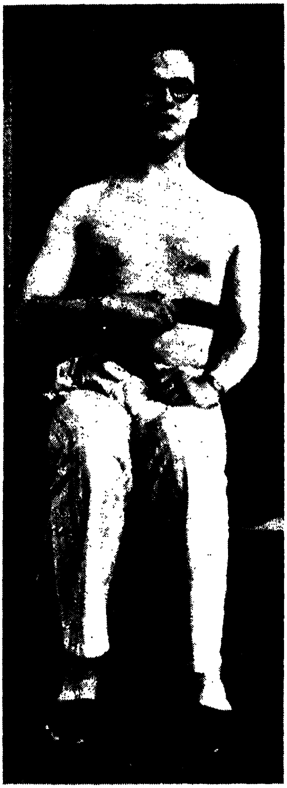

FIG. 137. — INSPIRATION. MOUTH SHOULD BE CLOSED.

BREATHING WITH BELT PRESSURE. FOR ONE SIDE. IT IS ALSO DONE BI-LATERALLY.

*From photographs lent by Miss Linton and Miss Reed.*

bending the body fowards, till the head is over the knees. Draw in abdominal muscles.

(*b*) Raise the body, pushing out the spine. The lowest part must touch the chair back first, then middle. Finally the shoulders and head are straightened.

During the up-raising the abdominal muscles must be drawn in, a pause being made in the breathing, but before the movement ends the abdominal muscles are relaxed and a new inspiration is taken.

(*c*) Expiration in sitting.

(*d*) A short inspiration in sitting.

Repeat the series 4 to 6 times.

(*a*) is carried out as slowly as possible, (*b*) more quickly.

*Trunk side bending.*

*Position.* Sitting. With feet apart. Right hand on upper ribs of same side.

(*a*) Bend slowly to right (in dorsal region) during expiration, giving pressure.

(*b*) Raise and bend slightly to left during inspiration, also swelling right ribs as much as possible.

Repeat to left side. 4 to 6 times.

*Single and Double Knee Up-drawing and Sinking.* A breathing exercise combined with work for abdominal and leg muscles. It helps expiration from the bases of the lungs.

*Position.* Lying. Knees drawn up. Patient lies back on pillows, arms aud shoulders relaxed.

(*a*) Draw right knee up slowly to chin during expiration and contract the abdomen.

(*b*) Pause in breathing, and sink knee to starting position.

*Breathe in,* relaxing abdominal muscles and expanding front ribs.

Repeat with left knee. 3 to 4 times each.

Then repeat both knees together raising during expiration.

Lower the knees quickly, breathe in and relax the abdomen. 3 to 4 times.

Repeat the whole series 3 times.

Between the special exercises given above the patient learns easy movements for relaxation, mobilising and to improve posture.

The following may be included :—

**Arm swinging, arm throwing sideways and circling.**
**Shoulder shrugging, rolling and elbow circling.**
**Head rolling, flexion and extension.**

Gentle trunk rolling.
Chest expansion.
General corrective position.
Chest clapping.
Leg swinging.

In lying position, the patient should stretch his neck, at the same time keeping the shoulders pressed in a downwards direction.

Class exercises are valuable, though much supervision is necessary to insure that the patient is breathing correctly.

## ADENOIDS

Adenoids are increased growth of the mass of lymphoid tissue present at the back of the nose of all young subjects. In children the lymphoid structure is soft and bulky and tends gradually to become absorbed. But if the adenoids increase and remain, towards adult life they become firmer and more fibrous.

*Symptoms.* Often not marked, but the following are usually present: mouth breathing, snoring when asleep, the voice is modified and there is inability to pronounce properly m, n, th, p, and t. There may also be a vacant expression, nasal discharge, deafness, and stunted growth.

The condition is often accompanied by enlarged tonsils, enlarged cervical glands, and thickening of the nasal mucous membrane.

*Treatment.* In most cases this is surgical, but after operation much can be done to improve the condition.

*Physical Treatment.* (*a*) Trains the patient to regain normal nasal breathing. (*b*) Improves the whole posture, and corrects any chest deformities. (*c*) Increases the exhange of oxygen and $CO_2$ in the lungs. (*d*) Improves the general nutrition.

The child is first taught to breathe correctly.

The nasal passages must be cleared by breathing out through the nose, and " handkerchief drill " practised. A shaking vibration may be given at the root of the nose to assist loosening any mucus. Alternate nostril breathing should follow, and then deep breathing taught in the usual way.

The mother should be instructed to train the child to keep the mouth shut both during the day and night.

### SUGGESTED TABLE FOR A CHILD OF TEN AFTER REMOVAL OF ADENOIDS

1. Breathing (in through mouth, out through nose to clear passages). " Handkerchief drill," and vibration shaking at root of nose. Alternate nostril breathing (in through nose, out through mouth).
2. Crook lying, brisk arm extension up and out.
3. Wing standing, alternate knee-raising.
4. Crook lying, deep breathing.
5. Wing stride sitting, back raising.
6. Neck firm sitting, chest expansion.
7. Crook lying, abdominal contractions, followed by deep breathing.
8. Neck firm sitting, chest clapping.
9. High ride sitting, alternate trunk side-bending and deep breathing.
10. Yard standing, marching with book on head.
11. Crook lying, deep breathing

Massage to chest and back.

# CHAPTER XXVI

DISEASES OF THE CIRCULATORY SYSTEM :—Blood pressure—HEART DISEASE — Pericarditis — Endocarditis — Aortic disease — Mitral disease — Myocarditis — Dilatation — Angina pectoris — Auricular Fibrillations—Congenital heart disease—Nervous heart disease—Physical Treatment—Nauheim treatment—Phlebitis and thrombosis—Embolism—Varicose veins—Phlegmasia alba dolens or White leg—Œdema.

**BEFORE** approaching the ways in which the circulatory system may be diseased, it is essential that the student thoroughly masters the anatomical structure and physiology of the normal heart, and the whole process of the circulation, and in order that the various abnormal changes which will be described later may be understood, a short account of the cause and meaning of blood pressure will now be given.

## BLOOD PRESSURE

Blood pressure is caused by :—

(*a*) The force of the heart's contraction, and the volume of blood leaving the L. ventricle.

(*b*) The quantity of blood in the arteries.

(*c*) The elasticity of the arterial walls.

(*d*) Peripheral resistance.

(*e*) The viscosity of the blood.

When the left auricle of the heart contracts, it forces blood into the arteries.

" Part of the force of the contraction of the ventricle sends blood into the aorta, and part goes to increase the expansion of the walls of the arteries, and at the same time the pressure of the blood. The blood pressure therefore rises and falls with the heart beat " (*Thornton*).

Arteries are tube-like structures containing within their walls a considerable amount of muscular and elastic tissue. Owing to their elastic properties they stretch when pulled, and increase in bore when distended. On account of the muscle fibres they contain, they keep their tubular form when empty.

During life the arteries are full of blood, and their walls are always on the stretch, for the blood is continually pressing upon them with considerable force. On the other hand, owing to the elasticity of the arterial walls, the vessel is exerting the same amount of force upon the blood, for " the reaction of an elastic substance is equal to the straining force." This equal pressure causes the blood to be squeezed on towards the capillaries.

When approaching the capillaries the blood has a force to overcome. An artery is continually branching and dividing, each branch becoming smaller than the last, but eventually all these small arteries cover a larger area than the original trunk ; the blood therefore has a large surface to cover, and its flow becomes gradually slower, just as the water of a river flows quickly when the banks are narrow, and becomes slower at its wider parts. While the blood is in the smaller arteries and capillaries (corresponding to the wide part of the river) its passage is hindered by considerable friction between it and the walls of the vessels. This friction is due to the greater extent of the vessel walls, and the slower passage of the blood through them. The friction causes what is known as *peripheral resistance.* It is greater in the small arteries than in the capillaries, for the blood is moving faster, and they have elastic walls, whereas in the capillaries the blood stream is slower and the elasticity of the vessel walls has disappeared.

A great deal of the pressure in the arteries is used up in overcoming the peripheral resistance, only just enough remaining to send the blood along to the veins. " Hence the blood pressure is greatest in the arteries, less in the capillaries, and least in the veins, and fluids always flow from a place of higher pressure to a place of lower pressure " (*Thornton*).

Muscular exercise and the movements of respiration help the blood flow in the veins. There is diminished pressure in the thorax when it enlarges during inspiration, and this causes blood to be drawn from the great veins into the right ventricle of the heart.

*The Pulse.* Every time the left ventricle of the heart contracts, fresh blood is pumped into the already distended arteries. This extra wave of arterial expansion is known as the pulse. The heart keeps up the force exerted by the stretched arteries and causes the blood to be squeezed on in them. The pulse may be compared to a wave produced by the wind on the surface of a slow stream; it travels at the rate of about 30 feet per second, whereas the actual blood flow is much slower, about 1 foot per second.

When examining a patient it is often necessary for the physician to ascertain the blood pressure within the arteries. This is done by an instrument called a sphygmomanometer. A pneumatic cushion is fastened round the arm, and distended with air until it exerts enough pressure to stop the pulse. When this takes place the pressure in the pneumatic pad is equal to that within the arteries. The pressure is then measured by the instrument, which shows a column of mercury rising according to the arterial pressure.

In the young adult the Systolic pressure rises to 120 mm. The Diastolic pressure to 80. The pulse pressure (*i.e.*, the difference between the systolic and diastolic pressure) to 40 mm. As people get older, the blood pressure rises; in a man of sixty it rises considerably.

In arterio-sclerosis, when the arteries become thickened, the blood pressure is greatly increased; if it rises above a certain height the blood-vessel breaks. When this takes place in the brain it may cause death from apoplexy, or paralysis of one half of the body (hemiplegia). The blood pressure is very high in chronic kidney disease (Bright's disease). It may reach 250 mm. In nervous excitable people the pressure is often higher than usual.

The lowest blood pressures are recorded in Addison's disease, when it may fall to 65 mm.

## HEART DISEASE

The heart may be diseased in many different ways, and due to various causes. The changes and symptoms which occur, however, are similar in all forms and may be given thus :—

*Changes.* The blood pressure in the arteries is usually lowered.[1] The rate of the blood stream is lessened. The exchange of gases both in the lungs and the tissues is lessened.

---

[1] In heart disease associated with kidney disease or arterio-sclerosis the blood pressure is raised.

The veins become overloaded. There is increased exudation of fluid in the tissues, producing œdema. All these changes increase the resistance to the blood stream and the work of the heart.

*Compensation.* The heart has always some reserve power upon which it can fall back when called upon to do increased work. So long as this reserve power is available, no perceptible change occurs, but when it is used up definite symptoms arise, *viz.* a further lowering of the blood pressure, lowering of nutrition, and a loading of the blood with $CO_2$.

*Failure of Compensation.* Mitral regurgitation into the left auricle results in pulmonary engorgement. The effort of forcing blood through the lungs means increased effort for the right ventricle. The muscular walls are thinner than the left and so they begin to dilate. When this occurs the tricuspid valves fail to close, the blood regurgitates into the right auricle, which becomes distended and offers resistance to the return of venous blood. This causes the systemic veins to become engorged, the organs are congested, and the stage is reached known as " failure of compensation."

*Symptoms.* Some or all of the following may be present :—

*Cyanosis* (blueness), due to the slow circulation and an excess of $CO_2$ in the blood.

*Dyspnœa* (difficult breathing), due to interference with the interchange of gases, viz., excess of $CO_2$ in the blood.

*Pain.* Sometimes a dull ache in the region of the heart, or sharp pain radiating up the neck and down the arms as in angina pectoris.

*Palpitation* on exertion. This consists of quick irregular beating of the heart, perceptible to the patient.

*Coldness* of hands and feet due to slow circulation.

*Œdema* of feet and legs, also due to slow circulation, and an extra amount of lymph being exuded. This is mostly seen in the extremities, but in severe cases it occurs in the abdomen, when it is known as *ascites* or *dropsy.*

*The Pulse.* This varies with the condition. In failing compensation the pulse is weak, rapid and irregular.

*Tachycardia.* This term is used when the heart suddenly beats at an abnormal rate. It may rise to 200 or 300 beats a minute. The condition may last a few minutes, or continue much longer.

*Cerebral Symptoms.* Seen in aortic disease, viz., syncope (faintness) due to anæmia of the brain, irritability, and depression.

*Nervous Symptoms.* Exhaustion, insomnia and irritability.

*Digestive Changes.* Constipation, indigestion.

## PERICARDITIS

Pericarditis is an inflammation of the pericardium—the serous sac which surrounds the heart.

There are various causes, the commonest being acute rheumatism, often seen in children.

There is an increased flow of blood to the part and serous exudation. The fluid effusion presses on the blood-vessels entering the heart, and interferes with its action.

## ENDOCARDITIS

Endocarditis is an inflammation of the lining membranes of the heart, and is often caused by acute rheumatism (p. 284).

It may be acute or chronic, also simple or malignant.

In the acute form there is swelling of the endocardium with deposits of fibrin on the valves. Later the valves become hard and fibrous. The deposits of fibrin cause the formation of small vegetations on the valves.

In malignant endocarditis, which is usually a septic condition, the vegetations are larger, and may become detached, forming septic emboli.

In both conditions the patient is very ill. The following symptoms may be present.

Rapid pulse, shortness of breath, alteration of heart sounds, prostration, anæmia, rigors, and high temperatures.

The malignant form is usually fatal.

In the chronic form also, the valves have become thickened and fibrosed, and there is the same formation of small vegetations.

The condition leads to chronic disease and deficiency of the valves.

*Incompetence* or *insufficiency* may be present. The valve has become scarred and contracted and fails to close the orifice so that blood regurgitates.

*Stenosis* may occur. The cusps are thickened and become adherent to each other, and the orifice is narrowed.

These two conditions may be present together.

**Aortic Disease.** The aortic valves may be affected in either of the above ways.

Compensation in aortic insufficiency is brought about by dilatation and hypertrophy of the left ventricle.

The symptoms are caused by poor arterial supply to all parts of the body. They are : Pallor, pain (is common in angina pectoris), palpitation, dyspnœa, headache, faintness, giddiness, insomnia, irritation and depression.

**Mitral Disease.** Stenosis and incompetence are often combined. Compensation is established by dilatation and hypertrophy of the left auricle and of the right ventricle. The symptoms are as those given in general symptoms.

## MYOCARDITIS

*Acute Myocarditis.* Inflammation of the heart muscle. Usually the result of acute rheumatism or other fevers. The heart is weakened, and may become dilated. The symptoms are the same as general heart symptoms and they vary in intensity.

*The chronic form of myocarditis* includes fatty infiltration and fatty degeneration.

In *fatty infiltration* there is increased deposit of fat in the connective tissue around the heart, and between its muscular fibres. The heart is hampered in its work and its force diminished.

*Fatty degeneration* is a more serious condition.

The following also occur :—

**Dilatation of the Heart.** Enlargement of the organ due to weakness of heart muscles. It may be due to overstrain, overwork, anæmia, rheumatism, or be the result of some acute disease such as typhoid, pneumonia, etc. There are the usual heart symptoms and sometimes the following are added : a weak rapid heart beat and pulse, which may be irregular, also breathlessness.

**Angina Pectoris** is a very serious condition. Attacks of pain occur suddenly in the chest, varying in severity. The pain spreads to the neck and head, and down the left arm. Sometimes down both arms. The chest becomes fixed. The patient cannot move or breathe deeply. The pulse may or may not alter. After the attack there is a feeling of great exhaustion. The attacks must be prevented if possible by avoiding any exertion which tends to cause them. Drugs are given to relieve pain. Capsules of amyl nitrite should be kept available to be inhaled during an attack.

**Auricular Fibrillations.** Is a term applied to a condition of the heart muscles. Certain fibres contract independently of each other. The auricle loses its power to force blood into the ventricle. The ventricular contractions are feeble, and do not reach the radial pulse.

The pulse is irregular and symptoms of heart failure may arise. Fibrillations may occur during the treatment of any form of heart disease.

**Congenital Heart Disease.** Known as morbis cordis. This is caused by defective development during fœtal life. There are many varieties. The valves are diseased and may be deficient. The most common form is pulmonary stenosis. Such patients are unsuitable for physical treatment. Many of them die young.

**Nervous Heart Disease.** This is a functional condition, and may be caused by excessive smoking, excessive drinking of tea, coffee or alcohol. It may also be the result of dyspepsia or anæmia.

There may be discomfort in the region of the heart, palpitation, rapid, slow, irregular or intermittent pulse, breathlessness, nervous symptoms, *e.g.*, insomnia, etc.

## Physical Treatment

*Treatment.*

The objects are :—

(*a*) To rest and relieve the heart as much as possible. This is especially important in the early stages.

(*b*) To improve the supply of oxygen and the interchange of gases in the lungs.

(*c*) To increase elimination of waste products and to improve circulation.

(*d*) To build up the heart muscle by progressive muscular work, viz., by active movements.

In giving massage it is necessary to aim at a sedative effect. Movements should be slow and rhythmic. Effleurage and kneading of the extremities and soothing stroking over the neck and back.

Abdominal massage is not given in the early stages, but is sometimes added later to remedy constipation, and to assist the portal circulation.

*Active Movements.* The patient's position must be restful and comfortable. Lying, the head and shoulders raised by pillows. The movements are given in progression, starting in the small joints. At first each movement is done once in each joint, but these are gradually increased. This depends on the reaction on the pulse rate.

Progression is made day by day, and movements in the larger joints are gradually included, *i.e.*, elbow and knee, shoulder and hip, and later the trunk.

By degrees resistance is added to the movements by the physiotherapist.

*Breathing.* The patient is instructed to do quiet breathing in time with his own respirations. All forced respiratory movements must be avoided.

The breathing helps the venous return, and the intake of oxygen.

Local heart treatment is of value in some functional cases (p. 47), but it can have no effect upon organic disease.

The pulse is taken before and after treatment, and a record of this should be kept.

Heart patients often exact from their nurse and physiotherapist much patience, care and tact. The patient must not be over-tired during treatment. Such signs as sighing, yawning, changes of colour, drawing of the mouth, perspiration, or faintness must be considered, and if necessary the treatment stopped. The patient should never be asked to lie prone or on the left side. The arms should not be raised above shoulder height.

When the patient is no longer confined to bed, and further progress may be looked for, a gymnastic table is given. This must be carefully graduated and should include :—

Breathing, easy extremity, and gentle trunk exercises, including trunk bending and turning. Rolling movements in the joints may be given, and modified active work. Resistance when applied must be light. No exercise must be chosen which impedes respiration.

A patient sometimes comes for treatment for other conditions, *e.g.* kyphosis, but if heart symptoms are present, hanging, forward lying, and raising the arms above shoulder height must be excluded.

The suggestions here given are according to the Swedish system. In some cases Nauheim treatment is ordered instead.

### A Suggested Table for a Heart Patient

1. Crook half-lying, quiet breathing.
2. Half-lying, arm kneading, and active wrist flexion and extension.
3. Half-lying, foot rolling, and active flexion and extension.
4. Reach grasp sitting, head rolling and head extension.
5. Quiet breathing.
6. Wing close sitting, alternate trunk side bending, (free).
7. Forward lean standing or sitting, spinal back hacking.
8. Crook half-lying, abdominal kneading (if suitable).
9. Wing stride lax stoop sitting, back raising, (free).
10. Half-lying, active forearm flexion and extension.
11. Half-lying, leg kneading, and active knee flexion and extension.
12. Half-lying, quiet breathing.

### THE SCHOTT-NAUHEIM TREATMENT

At Nauheim two doctors named Schott have systemised a method for the treatment of heart patients. It consists of a series of baths alternating with graduated exercises. There are springs of warm effervescing waters of varying strengths in which the patient bathes. The waters contain chloride of sodium, chloride of calcium, and a varying amount of carbonic acid gas. The course of baths begins with the springs weak in carbonic acid gas, and is gradually increased till the patient bathes in strong carbonaceous waters. The baths may be prepared artificially by adding the required ingredients to a given amount of water in an ordinary bath. Sandow's preparations for this purpose are well known. They are " put up in boxes containing four packets of bicarbonate of soda and eight tablets of acid sulphate of soda. Eight parts of the former exactly neutralise twelve parts of the latter, but the alkali should always be in excess. Thirty-two oz. of bicarbonate of soda with 22 oz. of acid sulphate will make a good bath of 40 gallons of water. . . . A whole packet of Sandow should be added to 40 gallons of water containing about 10 lb. of chloride of sodium and 10 oz. of chloride of calcium to make a strong bath. . . . At the commencement of the treatment, however, where no effervescence is desired, the bath can be made up with 4 lb. of chloride of sodium, and 6 oz. of chloride of calcium. Later, half a box of Sandow may be added to this, and later again a whole box used with the stronger brine. The material for brine can be easily obtained from the Salt Union at Nantwich" (*Luke and Forbes*).

The patient should lie in the bath entirely immersed in the water up to the neck. The temperature should at first be about 36° C. and be gradually lowered to 30° C. The patient remains in the bath for from ten to twenty minutes, but must not exceed the prescribed time.

The course generally consists of twelve baths, but not more than three should be taken in a week, and exercises are given on the alternate days.

## THE EXERCISES

### *Rules for giving the Exercises*

1. Every exercise must be given slowly and evenly.
2. No exercise must be repeated twice in succession.
3. There must be no compression in the grasp.
4. The patient must breathe freely all the time.
5. There must be a pause between each movement.
6. The physiotherapist must watch for changes in the patient, *e.g.* alteration in colour, perspiration, yawning, sighing, or drawing at the corners of the mouth.

If any of these signs appear, the patient should rest. If recovery takes place shortly, the treatment may continue; but if the signs recur, it should be stopped for that day.

The exercises must be given in a very restful position. In bed at first, or on a couch with the feet supported.

To begin with, passive movements are given in all the joints, beginning with the fingers of one hand, then the other; afterwards doing the same to the toes, and gradually working up to the larger joints. Each movement is performed once only and all are done slowly, and with a pause between each. Time, fifteen to twenty minutes.

At the next stage the movements are repeated actively with slight resistance, and the time increased. If necessary the whole series may be repeated.

At the next stage the movements are given in the sitting position.

Later the patient stands for the following :—

*Arm Exercises.* 1. The arms are held horizontal with the shoulders and are carried forward and then back again.

2. The arms are held close to the sides in supination, and the elbows flexed and extended.

3. The hands are linked in front, and the arms raised above the head.

4. The wrists are flexed and extended.

5. The arms are carried forwards to the horizontal position.

6. The arms are carried backwards, as far as possible.

*Trunk Exercises.* 1. Hands on hips, the trunk is carried forwards and raised. (Resistance when required is given upon the chest when going forwards, and upon the sacrum when raising.)

2. The trunk is rotated to the right and left. (Resistance may be given both ways, at the front and back of the shoulders.)

3. The trunk is alternately bent sideways.

*Leg Exercises.* The patient stands holding some support.

1. The leg is flexed backwards from the knee.

2. The leg is lifted up forwards as high as possible with the knee flexed.

3. The leg is abducted and adducted, the knee kept straight.

4. The leg is lifted forwards with the knee straight.

5. The leg is carried backwards with the knee straight.

6. The patient lies with shoulders and feet supported. The feet are flexed and extended.

The exercises must all be graduated in time and strength, resistance is added by degrees, and the time in some cases is increased to one hour. At the end of the course the patient learns to do the exercises alone, making resistance to the movements by contracting the muscles.

### *The Effects and Uses*

The immediate effects of the baths is to produce a glowing sense of warmth on the surface of the body. Small bubbles of gas adhere to the skin, which is strongly stimulated. The cutaneous vessels become charged with blood, to the relief of the overloaded heart. The patient often feels oppressed at first, but this soon passes off after two or three deep inspirations. The pulse becomes more vigorous ; at the same time it is reduced four to six beats per minute. The cutaneous vessels become dilated, while internal ones are contracted.

The output of $CO_2$ and urine becomes greater. The whole circulation is improved, as well as the general health and nutrition of the patient.

The effect of the exercises is the same as the baths, though the slowing of the pulse does not take place so quickly.

The following are some of the conditions when the Nauheim treatment is of great benefit :—

Fatty infiltration and impaired metabolism.

Chlorosis with dilated heart.

In cardiac dilatation from loss of tone after influenza or other depressing diseases.

Functional and neurotic heart disease.

In some cases of mitral disease.

In certain articular changes, which depend on the presence of an excess of uric acid in the blood.

## PHLEBITIS AND THROMBOSIS

Phlebitis is inflammation of the coats of a vein. It is often combined with thrombosis, though it may be present independently.

Thrombosis is the formation of a solid clot or thrombosis in the heart or vessels during life. The clotting may occur anywhere in the cardio-vascular system.

Some of the causes are : Injury to the vessel wall. Acute inflammatory changes, when phlebitis is usually present. Chronic inflammatory changes which cause a roughened surface within the vessel. A slowing of the circulation, due to general debility and wasting diseases. It may also occur with gout, tuberculosis, and syphilis.

"Thrombosis of a vein—generally of the leg—is usually spoken of as 'phlebitis.' The patient complains of pain in the part, either dull aching or sharp shooting ; and on examination one feels a firm rounded cord if the affected vein is superficial. The part is somewhat tender, there is usually slight œdema around the cord, and the skin over it may be slightly or markedly reddened ; these symptoms being due apparently to thrombosis causing a phlebitis and periphlebitis" (*Cantlie and Boyd*).

*Treatment* of these two conditions is much the same. Complete rest. The foot of the bed should be raised, and the limb fixed by a splint or sand-bags. When thrombosis is present the rest is essential to prevent a portion of the clot becoming severed producing the serious complication of embolism. In the early stages, hot fomentations are applied.

No massage can be given for two to three months, after the swelling and tenderness have subsided ; then the area of the thrombus should be avoided, *e.g.* if in the femoral vein, work on the outer side of the thigh only with effleurage. Even three months after, kneading and frictions must not be given over the area of the thrombus. Any fresh swelling or tenderness should be immediately reported to the doctor.

When the patient is allowed to walk, a firm and evenly applied bandage must be worn.

## EMBOLISM

An embolus is a portion of material within a blood-vessel which is carried along by the blood stream. It is usually a detached piece of a thrombus, but may be a fragment of various other tissues. When an embolus reaches the heart or lungs, it may cause sudden death.

In the treatment of thrombosis the possibility of embolism must always be remembered, hence the importance of complete rest until the thrombus is organised.

## VARICOSE VEINS

Varicose veins are those which have become dilated and lengthened. The walls are thickened and thinned in places, and the valves lose their function. The blood stream within the vessels is slowed. Either deep or superficial veins may be affected.

" A varicose condition of the saphenous veins is more frequently met with than in any other veins of the body, except perhaps the spermatic and hæmorrhoidal veins. The main cause of this is the high blood pressure, determined chiefly by the erect position, and the length of the column of blood which has to be propelled in an uphill direction. In normal vessels there is only just sufficient force to perform this task ; and in those cases where there is diminished resistance of the walls of the veins, these vessels are liable to dilate and a varicose condition is set up. This diminished resistance may be due to heredity, the vein-walls being congenitally weak, or it may follow inflammatory conditions of the vessels. Increased blood pressure in the veins, caused by any obstacle to the return of the venous blood, such as the pressure of a tumour, or the gravid uterus, or tight gartering, may also produce varix. . . . Both the saphenous veins in the leg are accompanied by nerves, the internal saphenous being joined by his companion nerve just below the level of the knee-joint. No doubt much of the pain of varicose veins in the leg is due to this fact " (*Gray*).

*Symptoms.* Pain, aching, and tenderness. If the superficial veins are affected, the dilatation can easily be seen. There may be swelling of the feet and legs. The following conditions may ensue: ulceration, thrombosis, phlebitis, embolism, rupture, and hæmorrhage.

*Treatment.* The most usual treatment to-day is by injection, and it is not, therefore, within the scope of this book. If, however, the physiotherapist is called upon, the following must be observed :—

The patient should take much rest with the limb raised. At night the foot of the bed should be made 2–4 inches higher than the head.

Bathing with cold water is sometimes advised.

No massage should be given if the veins are very distended and painful, but when these symptoms diminish cautious effleurage may be given, but even this should not be applied over any tender areas. The effleurage should begin above the dilated veins, and the lower parts of the limb be gradually encroached upon. Later kneadings and passive movements may be added with discretion.

When the patient is allowed to walk, a crêpe bandage gives comfort and support, or an elastic stocking is ordered.

## PHLEGMASIA ALBA DOLENS OR WHITE LEG

Phlegmasia alba dolens is the name given to a particular swelling of the legs. It is commonly considered to be a disease of the puerperal state, as it is mostly seen in lying-in women, though it does sometimes appear under other circumstances. The left leg is much more often affected than the right. Phlebitis and thrombosis are often present combined with inflammation of connective tissues and lymphatics.

*Symptoms.* There is at first acute pain along the course of the femoral vein. Sometimes the thrombosed vein can be felt. Later the pain spreads to the whole leg. The limb becomes swollen, white in colour (hence its name), and has a glossy appearance like polished marble.

*Treatment.* Such a condition is unsuitable for massage for some time after all acute symptoms have subsided, then the same lines should be followed as for thrombosis.

## ŒDEMA

Œdema is an abnormal accumulation of serous fluid in the inter-cellular tissues.

Notes on the physiology of absorption and the lymphatic vessels have been given already (p. 21) and must again be considered here.

Under normal conditions lymph is continually leaving the blood vessels to convey nourishment to the tissues. It is also constantly removed again, carrying away the products which have been exchanged for food. A larger amount of fluid is used when a structure is at work than when it is at rest. Much fluid passes through the muscles during exercise, and may remain in them for some hours. Its presence accounts for the feeling of stiffness often experienced after heavy exercise, the fluid being loaded with lactic and other acids which are fatigue products (p. 20). Œdema, however, is a pathological condition. The fluid in the tissues accumulates at a greater speed or in larger quantities than can be dealt with, and parts of the body become swollen. When the finger-tips are pressed into the swelling, a pit is formed, which again fills up as the displaced fluid returns, *e.g.* it often occurs over the dorsum of the foot and round the ankles.

When generalised through the body, œdema is called *dropsy*. This includes effusion into the pleura, pericardium and peritoneum. In the abdomen it is also termed *acites*.

Heart disease is the cause of most cases of gross œdema. As the result of valvular disease, there is an inadequate return of blood from the veins, or even a back thrust of blood into them. The veins and capillaries become conjested and œdema is the result.

Varicose veins in the legs are another cause.

Renal disease also produces œdema. The kidneys are unable to excrete enough water, and the tissues become overloaded with fluid.

Excessive œdema may occur in the arm after removal of the breast. As the axillary glands are usually taken away, the lymph channels are interfered with, and the arm may become swollen, hard and painful.

There is also inflammatory œdema, but this is dealt with elsewhere (p. 157).

*Treatment.* The cause must be removed as far as possible. If due to heart or kidney disease, massage (deep effleurage) may give relief, but must be applied with caution.

If the œdema is in the legs, the limb must be raised both before and during treatment.

Effleurage strokes must begin above the œdematous part, and be carried to the glands of the groin. This helps to clear the lymphatics, then the hands gradually pass over the lower areas, and last of all the ankle and foot receive attention.

It is wrong in these cases to begin by treating the foot, and then the lower leg and thigh.

Later kneading may be added and passive movements.

An œdematous arm must also be raised, and effleurage given on the same lines, *i.e.* first deep strokes over the shoulder area, then the arm, forearm and hand, always carrying the strokes towards the lymph glands. Later kneading and passive movements are added.

After the union of fractures, œdema may be dispersed by the pressure of massage. The limb should be raised, and much effleurage given. Later kneadings, frictions, and movements are of service.

# CHAPTER XXVII

NERVES AND NERVOUS DISEASES :—The nervous system—The structure of nerves—Upper and lower motor neurones—Reflex action—Paralysis—Classification of the two types—AFFECTIONS OF THE UPPER MOTOR NEURONES :—Hemiplegia—Recovery of muscle groups—Treatment for old-standing hemiplegia—Paraplegia—Spastic paralysis in children—Encephalitis lethargica or sleepy sickness—Multiple or disseminated sclerosis. AFFECTIONS OF LOWER MOTOR NEURONES : –Progressive muscular atrophy—Anterior poliomyelitis or infantile paralysis—The iron lung.

A THOROUGH knowledge of the structure and function of the nervous system is essential to the student of physiotherapy. We may assume that this knowledge has been acquired, and will only here recall the following important facts :—

Nerve impulses are generated in the brain and are carried, by means of the spinal cord and nerves, all over the body.

The nerves are given off from the cord in pairs, on each side, and pass out through the vertebral foramina. The nerve leaves the spinal cord as anterior and posterior nerve roots. The anterior is an efferent or motor nerve. The posterior is an afferent or sensory nerve. Before leaving the vertebral foramen, the anterior and posterior roots join and form one trunk called a mixed nerve. It contains both afferent and efferent fibres.

Nerves are structures of very varying sizes, *e.g.* the sciatic nerve is about the thickness of the little finger, and the median may be likened to the calibre of a thin pencil. Other nerves are smaller, varying very much in size.

A nerve trunk is composed of bundles of nerve fibres enclosed in sheaths. Many hundreds of fibres are found even in the smallest peripheral nerve, and the structure of the fibres can only be seen and studied microscopically. The axon is the central part of the nerve fibre, and its function is to conduct impulses. It runs either *from* its cell body in the cord, or *towards* its cell body in the posterior root ganglion.

The axon may be likened to the strands of wire in an electric cord. It is first covered by what is known as the *myelin sheath.* This sheath is not continuous, but has constrictions at intervals called *nodes.* Its function is probably to nourish and insulate the axon.

Outside the myelin sheath is the neurilemma or sheath of Schwann, and outside again is a connective tissue sheath.

Changes occur in the fibres when a nerve is cut or divided, and also in certain lower motor neurone diseases, *e.g.* anterior polio-myelitis. These conditions will be dealt with in later chapters.

## UPPER AND LOWER MOTOR NEURONES

Before the different kinds of paralysis can be understood, it is necessary to explain more fully how the nerve impulses in the body are controlled.

The nerves passing to and from the brain are arranged in what are called motor and sensory tracts.

A motor nerve has its origin on one side of the brain in the cerebral cortex. It crosses over to the opposite side in the medulla, and continues down the spinal cord. It is then carried by means of the spinal nerves to the various muscles which it is its particular function to supply. This explains why a lesion involving the motor area of one side of the brain causes paralysis of the muscles on the opposite side of the body.

The motor tract, for purposes of study, is divided into two parts called the upper and lower motor tracts or neurones.

**The Upper Motor Neurone** comprises : the motor cell in the cortex of the brain, and its descending nerve fibre down to a cell in the spinal cord.

An efferent impulse passes from the nerve centre, causing a muscle to contract. Another set of fibres comes at the same time and inhibits or checks the contraction (inhibitory nerves). Interruption of the upper motor neurone stops the inhibition, and so the muscle continues to contract, and remains in a state of spasm. This explains the condition found in spastic paralysis. It is therefore a lesion of the upper motor neurone.

**The Lower Motor Neurone** includes the nerve cell in the cord, together with the nerve which proceeds to the periphery.

Lesions of the lower motor neurone are caused by some injury or disease of the spinal nerve cell, or the peripheral nerve given off from it. The control of muscle tone is altered and nutrition impaired. The result is a flaccid condition, combined with atrophy or wasting of the muscles concerned.

## Reflex Action

" Reflex action is the immediate efferent response to an afferent impulse, independently of the will, the disturbance set up by a stimulus to an afferent nerve being reflected along an efferent nerve to a muscle or gland " (*Thornton*).

Reflex actions are normally taking place continually in the body. Blinking of the eyelids, sneezing and coughing are familiar examples.

There are some reflexes the performance of which are used by the physician for purposes of examination. These are called the deep reflexes. They are present in health to a certain degree, in disease they become obliterated or increased. If, with the knee flexed and the muscles relaxed, a sharp tap is given over the ligamentum patellæ, the lower leg springs suddenly forwards and sinks again. This takes place independently of the will, and is normal in a healthy person. It is called the patella reflex.

If an inhibitory nerve is constrained in the upper motor neurone, reflex action is increased in the lower motor neurone. This accounts for the reflexes being increased in spastic paralysis. In flaccid paralysis the reflexes are absent.

The Postural Reflex of the body has already been mentioned (p. 60).

## Paralysis

" By paralysis is meant the inability to move voluntarily a certain muscle, or muscles, or to appreciate any of the ordinary sensory stimuli " (*Taylor*).

## Classification of the Two Types of Paralysis

| INJURY OR DISEASE OF THE UPPER MOTOR NEURONES | INJURY OR DISEASE OF THE LOWER MOTOR NEURONES |
|---|---|
| 1. Spastic muscles. | 1. Flaccid muscles. |
| Caused by interference of control of movement in brain cortex. | Muscles have lost tone, which is controlled in the spinal cells. |

| | |
|---|---|
| 2. Very slight wasting.<br>Any present is due only to disuse, for nutrition is not interfered with. | 2. Marked wasting of muscles.<br>Nutrition is interfered with because the trophic centres in the cord are injured. |
| 3. Normal appearance as regards circulation.<br>The nerves of the blood-vessels are normal. | 3. Cold and blue in appearance.<br>The nerves supplying the blood-vessels are affected. |
| 4. Reflexes are increased.<br>The action of the inhibitory impulses is stopped. | 4. Reflexes are abolished.<br>The connection between the nerve cells in the anterior and posterior horns of the cord is interrupted. |
| 5. Electrical reactions are normal. | 5. Electrical tests show reaction of degeneration. |
| 6. Contractions may occur.<br>Due to adhesions, and the joint being held in flexed positions. | 6. Contractions may occur.<br>Due to the over-action of non-paralysed muscles. |

## Affections of the Upper Motor Neurones

### HEMIPLEGIA

" By ordinary hemiplegia is meant paralysis of the lower half of the face and tongue, and of the limbs on the corresponding side. The trunk muscles are also involved on the same side, though to a lesser extent than the affected limbs " (*Guthrie*).

This condition is usually caused by cerebral hæmorrhage or apoplexy, which either temporarily or permanently damages the upper motor tracts.

During the early stages of cerebral hæmorrhage the follow ing symptoms occur : Sudden loss of consciousness, stertorous breathing, cyanosis of face, hard high-tension pulse hemiplegia and aphasia (loss or alteration in power of speech).

*Treatment.* At first complete rest. The limbs must be kept in a good position, and the weight of the bedclothes should be kept off the foot. The whole limb should be rotated out and abducted, the foot dorsi-flexed and everted, to correct the tendency to take the opposite positions.

Adduction of the shoulder may be prevented by placing a sand-bag in the axilla. The elbow should be kept extended.

The patient may be told to alter the position of the hand himself, with his good hand.

*Note.* At this stage the limbs probably lie in a flaccid condition, later they may become spastic.

*Physical Treatment.* Every effort must be made to relax the spastic muscles. Warmth is important, and deep breathing should be taught. When massage is ordered much effleurage should be given over the limbs, and later muscle kneading may be added.

Passive movements in all the joints must begin as soon as possible to prevent formation of adhesions, and to improve circulation

The physiotherapist must watch for signs of returning power and encourage the patient to do small active movements. A re-education board may be used, and suspension slings are of great value when available for supporting the limb.

(For further re-education exercises, p. 64).

Massage for old-standing cases of hemiplegia differs somewhat from the above, but before giving it in detail several more points on the subject must be discussed.

It has been explained by scientists that the neurones require stimulation for the performance of their functions, and that they depend upon the normal movements of the body for this stimulation. Tension of skin, muscles, tendons, and ligaments also affects them. If these normal processes are in abeyance as a result of paralysis, some artificial stimulation must be given in their place. Massage and passive movements are invaluable for this purpose. By their use in such cases atrophy is arrested, nutrition in the muscles is improved, the circulation of the blood and lymph increased, and stiffness in the joints prevented. The manipulations probably also have an effect upon the nerves and their centres.

In old-standing cases it is continually seen that certain muscle groups become more spastic than others, in fact the affected ones may become permanently contracted. " Muscles contracted in this way should never be forcibly stretched, but coaxed to relax by gentle, steady traction and much effleurage. Petrissage and tapôtement stimulate the muscles to further contraction, and therefore should not be applied to those which are already in a hypertonic condition. On the other hand the above-mentioned manipulations are useful in improving the tone of the uncontracted muscles " (*Guthrie*).

*Recovery of the Muscle Groups.* This takes place gradually, the proximal parts regaining their power before the distal, and usually the leg recovers before the arm. The flexors usually regain strength before the extensors. (When this is the case concentric and eccentric muscle work is necessary.)

If a large part of the cerebral tract has been destroyed, complete recovery can never take place, but in the worst cases some improvement may be gained by careful treatment, also by the patient's own efforts.

" Generally speaking, the less the spasticity and wasting, the better the prognosis. Motor paralysis is of less grave significance than spasticity " (*Guthrie*).

*Treatment for Old-standing Hemiplegia.* Assuming that the patient can walk, and has some movement in the upper extremity, re-education must progress. Breathing and relaxation exercises must continue.

*For the Arm.* Continue massage. Effleurage, petrissage and kneading of weak muscles (extensors). Tapôtement may be added (but omitted if it increases spasm). Frictions round joints.

*Passive movements* in as full a range as possible with effleurage in between to relieve spasm.

*Active movements* on re-education board and in suspension sling. Concentric and eccentric muscle work, and gradually adding resistance.

When improvement allows, simple, free double-sided exercises are taught.

*For the Leg.* Assuming there is considerable recovery, the patient should learn to frequently abduct, rotate out, and evert the lower limb.

Active movements may be attempted on the re-education board, but suspension slings are best if available.

The movements should be carried out first in their outer range, later in middle and inner ranges. Movements at first done once or twice, but increased by degrees.

Marching in spaces to counting, always placing the paralysed limb forwards first. The support of an attendant is better than a stick or crutch, as it can be gradually lessened as the patient gains confidence. Foot-drop may be corrected by sitting with a strap round the foot, and pulling on the strap; also by flexing the foot on the bar of a chair, or the lowest rung of a ladder.

For further muscle re-education, see p. 64.

Pool therapy is sometimes beneficial.

## PARAPLEGIA

" Paraplegia is paralysis of the lower extremities, usually associated with paralysis of the lower part of the trunk, bladder, and rectum " (*Bastian*).

This condition occurs from a variety of causes, and there are several types. It is sometimes associated with tubercular disease of the spine, when it is the result of pressure on the cord. It may be due to organic disease of the spinal cord or it may be purely functional.

The paralysis is usually of the spastic type, and there is generally incontinence of urine and fæces, owing to paralysis of the sphincter muscles.

*Treatment.* Must be carried out on the same lines as for hemiplegia. Massage of the lower limbs, *viz.*, effleurage to reduce spasm, adding petrissage and tapôtement of the weak muscles. Mobility must be maintained in all the joints, and re-education exercises chosen according to the patient's power, and gradually increased.

A re-education board and slings if available are of great value. As power returns, re-education in walking must be attempted.

## SPASTIC PARALYSIS IN CHILDREN
## OR CEREBRAL PALSY

This is a condition seen in young children which more often affects the control rather than the loss of power of movement. The muscles show a varying degree of spasticity and are weak and rigid. The condition is an upper motor neurone affection. There are several types :—

Infantile hemiplegia, affecting one side of the body.

Infantile paraplegia, affecting the lower extremities.

Infantile diplegia, affecting both sides of the body.

Any of these forms may be congenital, due to injury at birth, or be the result of some illness.

The child may be mentally deficient, but this is not always the case.

A variety of symptoms present themselves and must be dealt with as they occur. The child is often unable to control his movements; there may be interference with growth, and contractions often appear.

*Treatment.* The general health must be improved as much as possible by careful nursing, suitable diet and warm clothing. Much care and patience is required to train the child mentally.

Massage and movements may be given to improve nutrition and circulation. Easy free exercises should be taught to help will power, concentration, and the co-ordination of movement. Deformities must be dealt with if they appear.

A British Council has recently been set up to deal with the welfare of patients suffering from this disability now usually called cerebral palsy. Methods of treatment have lately been introduced from America, several doctors and others having visited the United States to study the methods there used.

No doubt a field of useful work has begun, and will develop still further for the benefit of these patients.

## ENCEPHALITIS LETHARGICA, OR SLEEPY SICKNESS

Encephalitis Lethargica is the name given to a disease which was first described by a doctor in Vienna named von Economo in 1917. Serious pathological changes take place in the nervous system due to " toxi-infectious degeneration of the nerve cells " (*Hall*).

The part most usually attacked is the grey matter of the basal ganglia, mid-brain, and pons Varolii.

The disease shows many symptoms during its progress. Among them are—Fever, and lethargy in varying degrees, headache, disorders of the eyes, hiccough, rhythmic movements, chorea-like movements, mental disturbances, epilepsy, apoplexy, changes in the gastro-intestinal and urinary systems, etc.

The mortality in this disease is considerable, but when the patient survives the acute stages there may be serious after-effects which remain or reappear at intervals.

The prognosis is variable. Some patients recover completely, while many are left with some disabling after-effect.

Frequently these patients develop a condition similar to that of Parkinson's disease or paralysis agitans. The face assumes a mask-like expression and slowness of movement is marked. A patient may stick in the middle of a movement and remain in an awkward position.

Some may be over-active and restless, or be affected by swift emotional changes, and they may lose the power of control.

Deformities may arise, *e.g.* kyphosis, lordosis, flat foot and flexed joints as a result of over-tension of various muscles.

Tremors are often present and speech is indistinct.

Balance is sometimes disturbed, causing running backwards.

There are vasomotor changes, the patient feeling the cold in winter, and chilblains are common.

Respiratory troubles may appear and sometimes hemiplegia or diplegia.

There is one group of these cases which show changes in behaviour. Some are subject to obsessions ; others develop a violent temper, become untruthful and dishonest, till eventually they are classed as delinquents.

*Early Treatment.* This is entirely in the hands of the doctor. Good nursing is essential and various drugs are given.

*Later Treatment.* Light massage and regulated passive and active movements may be ordered. Re-education exercises for all parts of the body should be attempted and must be devised according to the powers of the patient. Rhythmic movements performed to music are sometimes beneficial.

In an article which appeared in the *Chartered Society's Journal,* Miss Silvia Cowles has given an account of her methods of treating children suffering from post-encephalitis lethargica. She explains how different types of cases need different handling. Some are best treated in a class, while others require individual attention.

Miss Cowles considers that class work has both physical and moral value. The child's interest is kept up by ever-changing exercises. When slow and lethargic he catches rhythm and movements are hastened. The restless, over-active child is also helped in a class by balance and other movements.

Miss Cowles also advises class games. She says it is often difficult for the children to accept defeat. They will accuse each other of cheating and show impatience, temper and sulks.

The teacher must be ever ready to manage such situations. " Brain storms " should be avoided at all costs.

If a child becomes tiresome in a class he should be told to sit down till he feels better. He is really demanding attention, but if left to himself instead of making a sensation he will subside.

These children should be praised when they do well, and the teacher should listen when they try to explain something which has disturbed them.

*Individual Treatment.* This must vary according to the special symptoms, and the patient should be taken to a department where there is access to Swedish plinths, wall-bars, etc.

Deformities must be counteracted.

The Parkinsonian condition often presents difficulties, but easy exercises must be devised. The patient may fall about or suddenly collapse on the floor.

Miss Cowles says " untrained Parkinsonian cases mostly expect everything to be done for them : they are a dead weight and make no effort to help themselves and even when one tries passive movements on them the rigidity of their muscles has to be overcome, so that considerable effort has to be used."

She considers re-education of movement of greater use than prolonged massage. These patients will undergo any amount of passive treatment, but his mind and emotions must be aroused and he will eventually be eager to progress.

Psychological treatment is important and the patient's interest must be aroused. In some cases they must re-learn to use their hands, and so simple games must be devised. Skipping is useful for the slow type of patient.

A point has been gained if the patient can concentrate his mind on the game or action and forget his disability.

Much patience and perseverance is required by the physiotherapist in the treatment of these cases.

## MULTIPLE OR DISSEMINATED SCLEROSIS

This is a disease of the nervous system in which patches of sclerosis (hardening) appear in the brain and spinal cord. The patches are situated mostly in the white nerve matter ; though they also occur in the grey. This means that fibres or tracts in the central nervous system are more affected than nerve cells. There is an inflammatory condition which tends to clear off for a time and then appears again. The nerve axons therefore cease to function while pressed upon by the inflammatory condition, but recover when pressure is removed.

The cause of the disease is not definitely known. It is seen in young adults of both sexes generally between the ages of fifteen and thirty-five.

The changes generally begin in the posterior columns of the cord, causing loss of sense of position, and also in the crossed pyramidal tracts, causing loss of power and spasticity. The cranial nerves may be affected, especially the optic tract, and the nerves controlling the movements of the eye.

*Symptoms.* In the early stages they may be slight and last for a short time only. Later there may be spasticity of arms and legs and increased knee-jerks. Coarse tremors in the hands when the muscles are used, which are called "intention tremors." These are seen when picking up an object, or when the patient is asked to touch the tip of his nose with his forefinger.

Nystagmus, which is oscillation of the eye-ball.

Staccato or slurring speech, and alterations in the voice, because the patient cannot control the muscles of the larynx and pharynx.

There are inco-ordinated movements caused by changes in the medulla and cerebellum.

The mental condition may become weak and the patient is emotional. The sphincter muscles of the bladder and rectum are sometimes affected. Trigeminal neuritis may occur.

The disease is incurable. Its progress is slow and may extend over a period of five to twenty years.

*Treatment.* The general health of the patient must be maintained as far as possible. Much rest and freedom from worry and anxiety with a full nourishing diet, are very important factors.

Breathing exercises and relaxation must be taught and practised daily.

Massage and passive movements followed by active re-education are of great value throughout the course of the disease—on no account should the patient be over-tired. Massage should be given in the form of slow rhythmic kneadings. In chronic cases when possible the kneadings should be double-sided, two operators working simultaneously. Such manipulations are soothing to the patient, and if given in this way the treatment time is shortened, and the patient less apt to be fatigued. Every effort should be made to overcome spasticity, and to obtain relaxed movements in the joints. There must be no forcing. In re-education the movements must be done slowly to counting. At first, the patient is treated in bed, later in the sitting position. The use of slings to support the limbs are a great help. Later progression is made to standing and walking, and eventually a general table of exercises may be given, paying much attention to balance and posture. Exercises up and downstairs are useful. Abdominal massage is often found beneficial.

Frenkel's exercises are often used. After careful re-education, the patient finds he has recovered the control of certain movements which he had lost. Various forms of occupational therapy are of value to these patients.

Various forms of electric treatment may be ordered, *e.g.* sunlight, galvanic baths, and sometimes general diathermy.

## Affections of the Lower Motor Neurones

### PROGRESSIVE MUSCULAR ATROPHY

Progressive muscular atrophy is " a slow wasting of the muscles, beginning in some particular part, spreading and increasing until it is wide in extent and extreme in degree. The changes in the muscles depend upon a slow degeneration in the ganglion cells of the anterior cornua of the spinal cord, accompanied by a degeneration in the motor nerve fibres arising from the cells. With this degeneration of the cells and fibres there is usually also associated a similar change in the pyramidal tracts of the cord, sometimes at least to be traced up to the motor cortex of the brain, and related to a similar degeneration of their ganglion cells " (*Gowers*).

This is a rare disease of adult life, and is seen more often in men than in women.

The causes are : mental distress, exposure to cold, injury (rarely), lead poisoning, and syphilis.

*Symptoms.* Wasting of the muscles. This usually begins in the small muscles of the hand, viz. the thenar eminence and the interossei. Then the wasting gradually spreads up the arm to the shoulder and trunk. Lastly the legs are attacked, but the head remains unaffected. The muscles become weak and flaccid. There are vague pains in the affected parts. Twitchings and tremors may occur. Numbness may be complained of, but there are no real sensory changes. The course of the disease extends over many years.

*Treatment.* This disease is incurable, but symptoms may be alleviated by attention to general conditions. The patient should have fresh air and gentle exercise, and mental worries should be avoided.

Massage may be given gently to the affected parts. Effleurage, muscle kneading, nerve vibrations, hacking down the spine, and passive movements.

The patient must not be overtired by the treatment, but exercises may be given according to his strength. Free movements combining eccentric work are helpful. As the disease progresses it is probable that the patient will be able to do less and assistance must be given with the exercises. All joints must be kept supple, and every effort taken to prevent contractions. The patient must be kept on his feet as long as possible and not allowed to become bed-ridden.

### ANTERIOR POLIOMYELITIS OR INFANTILE PARALYSIS

Anterior poliomyelitis is a fairly common disease which attacks children generally between the ages of eighteen months and two years. It also appears during adolescence, and no age is exempt. In this country it usually appears in isolated cases, but epidemics do occur.

It is an affection of the lower motor neurones, for the cells in the spinal cord either temporarily or permanently lose their function, and the peripheral nerves given off from them are consequently paralysed.

It is an acute infectious fever, and may be passed from one person to another. It is, therefore, one of the infective diseases which are notifiable to the Medical Officer of Health. It is caused by a toxin produced by a minute micro-organism which enters the body either through the intestines or through the nose and throat. The poison is carried by the lymphatics accompanying the olfactory nerves into the brain, and from thence to other parts of the nervous system.

There are three types of the disease :—

1. Bulbar, when very vital centres are attacked. Such cases usually prove fatal.

2. Abortive, when the acute symptoms are present but there is no paralysis. These are mostly seen in epidemic form.

3. Spinal, when the nerve cells in the anterior horns of the grey matter of the cord are attacked, resulting in paralysis of various parts of the body. This is the commonest.

The following changes occur: Acute inflammation in the anterior poles of the grey matter of the spinal cord. Fluid is exuded into the surrounding tissues, causing pressure. If the fluid is soon absorbed, the pressure ceases and the parts recover. Sometimes the nerve cells are destroyed, then the part can never recover. After the inflammation has subsided, definite scars are left upon the nerve tissue. If the inflammation continues, there is degeneration of the nerve fibres given off from the cells, the muscles they supply rapidly waste and subsequently undergo fatty degeneration. The paralysis depends upon the amount of the inflammation. It may be slight or extensive, but it is characteristic of the disease that it is worst in the early stages. It is seldom that all parts of the body remain permanently affected, and it is rare that all muscle groups entirely recover, but when a part has recovered it does not again relapse into the paralysed condition.

The cervical and lumbar regions are the parts of the cord most often affected, resulting in paralysis of the extremities.

The parts which remain paralysed are very variable. Sometimes a whole limb, sometimes one muscle group, or a single muscle.

The disease has three clinical stages: (*a*) the acute; (*b*) the stage of recovery; (*c*) the chronic.

*The Acute Stage.* The illness generally begins with a chill or feverish attack. The incubation period is seven to fourteen days. There may be temperature up to 103° F. Sore throat, vomiting, loss of consciousness, nervous irritability, or extreme drowsiness, stiffness of the neck and back. The limbs may be painful and tender to the touch.

These early symptoms continue for a variable time from one day to two weeks, and then the paralysis appears.

In some cases these symptoms are absent. A child may go to bed apparently well and wake the next morning with a powerless limb or limbs.

*The Stage of Recovery.* When the acute symptoms have subsided, there is usually a certain amount of spontaneous recovery of the paralysis. This may continue for a time, but more or less the following signs will be present :—

Paralysis with flaccid and wasting muscles. The affected parts are cold, and sometimes blue in appearance. The reflexes are lost. There is reaction of degeneration when the muscles are tested by electricity.

*The Chronic Stage.* This need not be considered until the condition has remained stationary for some months, or even up to two years. Then the paralysis still present will represent the patient's disability.

*Treatment.* In acute stage :—

The patient should be isolated and should be kept quiet and very warm. Complete rest in bed is indicated. The joints should be kept in a neutral position to avoid deformities. The child should lie flat with thighs slightly abducted, the knees straight, and feet at right angles. Such positions must be maintained by the use of sandbags, splints, or best of all a plaster moulding is made.

If the upper limb is paralysed the arm should be abducted, the forearm flexed and supinated, and the hand slightly dorsi-flexed.

When it becomes clear which muscle groups are affected, it is important that the limbs are placed to allow the greatest relaxation to the weakest groups, *e.g.* a drop-foot paralysis, where the tendo-Achilles is unaffected, should be dorsi-flexed a little beyond a right angle.

No physical treatment is indicated at this stage. Massage and electricity must not be given.

The stage of recovery :—

*Testing.* Before a definite line of treatment can be adopted the physiotherapist must carefully investigate the condition of the patient's muscles. As a rule some remain normal, some are found to be weak, while others will be completely toneless and paralysed.

Each muscle group must be tested placing the limb so that gravity neither assists nor resists the movement. Only the patient himself can contract the muscles, but by urging him to try he is attempting to send an impulse from his brain to the muscle group in question.

The muscle must not be overtired, so not more than three movements should be done at first.

A chart is kept to record the movements when the examination is done, so that progress can be registered.

Professor Seddon has written recently that he " advocates as a necessary diagnostic procedure the making of a muscle chart at the stage of maximum affection in accordance with the recording system recommended by the Peripheral Nerve Injuries Committee of the Medical Research Council."

The charting should show the differences found in the muscles ranging from normal movement to no movement. Between these two points the movement may be fair, weak and differing when gravity assists or resists.

Charting becomes complicated when the paralysis has been extensive. Details of such methods are given in *The Physical Treatment of Poliomyelitis*, by Miss Diana Kidd, M.C.S.P.

Electrical testing by Faradism and galvanism is also used, but not in the early stages of treatment.

The testing is usually done by the medical officer, the physiotherapist co-operating with him.

*Physical treatment* during stage of recovery. Some form of heat is generally used. Radiant heat, infra-red and sometimes diathermy.

The position of the limbs during treatment should remain in the same position as on the splints, and the affected muscles must not be overstretched.

Light massage improves the circulation, but should only be given for a few minutes at a time (not more than 10 minutes). It is often well to give massage between exercises. Vibrations may be given, but no tapôtement till the muscles have gained some power.

*Passive Movements.* These may begin as soon as early feverish symptoms have passed, but notice must be taken if the muscles are still tender. At first the movements are done to a limited degree, but *a full range* is carried out as soon as possible. The limb must be well supported throughout, and one movement only given in each direction within the limit of pain.

A paralysed muscle must not be stretched, also if the muscles remain very flaccid, the movements must not be carried past their normal range, *e.g.* if the hamstrings are paralysed, the knee-joint easily over-extends.

*Active Movements.* Assisted and free active movements are added as soon as there is any sign of power to do them. When once a voluntary contraction of a muscle occurs, movement should first be done in the middle and inner range.

The exercises must be carefully graduated, and the muscles never over-tired.

The physiotherapist is here referred to the chapter dealing with muscle re-education (p. 65) and must arrange a scheme of treatment for her patient according to the muscle groups affected.

It is of great importance to bear in mind the facts of mechanical advantage, *viz.* placing the limb in such a position that gravity first aids the movement, etc. The amount of friction between the limb and the surface upon which it lies must be reduced as far as possible. This is done by the use of a re-education board, or by placing the limb in a sling. The sling bears the weight of the limb, and so allows the weak muscles to perform movements they could not otherwise accomplish.

The line of pull of the muscles, and the changes of leverage must also be taken into consideration (p. 65).

Sometimes one or more joints become stiff. The condition is difficult to overcome, but movements must be carefully attempted, and good positions maintained as far as possible.

Great benefit may be derived if a swimming pool is available. The child is held, or placed in a sling, and urged to move his limbs in the water. Frequently he soon performs movements he has previously been unable to do, and he may learn to swim, when he is unable to walk.

If a swimming pool is unavailable a young child may be placed in an ordinary bath of warm water and taught to do exercises. Though space is limited, the limbs are supported by the water, while the child attempts the movements. By degrees the patient is placed in half-lying and sitting positions to perform exercises, but it depends on the amount of disability as to how this can be arranged.

**Deformities.** The physiotherapist must watch daily for deformities which may develop quickly. At the first signs of a contracture, the soft structures must be stretched, and it may be well to hold a joint in a corrected position for a time each day.

The contractions are due to the pull of a stronger muscle group over a weaker. Splints must be watched and adjusted.

It may be necessary to keep a contracted part in extension for a time, *e.g.* for contracting hip adductors, the legs must be placed in wide abduction, 2 or 3 times daily for short periods.

Scoliosis may appear as the result of paralysis of the small muscles of the back. Preventive precautions must be taken. A plaster bed is probably ordered, and the patient must do graduated trunk exercises.

Foot deformities easily arise such as talipes equinus, calcaneus, varus and valgus. All means should be taken to avoid these conditions, but should they have occurred before the patient is brought for treatment, orthopædic methods may be necessary. Muscle training should be carried on when possible.

Daily treatment is continued, *viz.* massage and re-education exercises. These are gradually increased and made harder as the patient improves.

For a small child often no apparatus is required, but for older patients whose limbs are heavy and difficult to support, a re-education board and slings are invaluable, and ultra-violet rays may be ordered.

Eventually standing and walking exercises are practised, at first with the support of apparatus and gradually without as power returns. All must be done in gradual stages, avoiding fatigue.

The treatment must be carried on for months, and great patience is required. Continued improvement may be expected up to two years after the onset of the disease.

*Treatment.* In chronic stage :—

Exercises and massage may be continued if found to be of benefit, but at this stage, viz., two years after the onset of the disease, if paralysis remains, various appliances will be required to help the patient to maintain his position and to walk.

If there is shortening of a limb, a high boot must be worn, or in some cases a caliper is fitted, *e.g.* for paralysis of quadriceps or the peroneii muscles.

The support given entirely depends on the disability, and will be ordered by the surgeon or physician in charge of the case.

When a patient has received the postural treatment here described, deformities should not arise. If they do so, surgical treatment becomes necessary. At a later stage the function of a limb may sometimes be improved by arthrodesis of a joint or the transplantation of tendons.

### THE IRON LUNG OR BOX RESPIRATOR
### DRINKER'S APPARATUS

In some cases of poliomyelitis the muscles of respiration become involved, the nerves supplying them being paralysed.

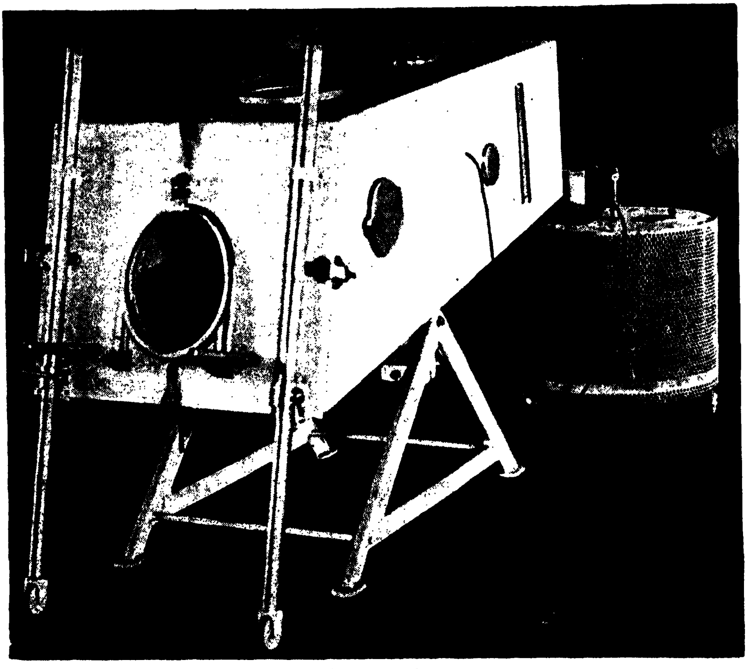

FIG. 138.—THE IRON LUNG. DRINKER'S APPARATUS.
*From The Nursing and Diseases of Sick Children.*
*London: H. K. Lewis & Co. Ltd. Ed. by A. Moncrieff.*

When this happens, the patient is placed in an apparatus which by mechanical means supplies continued artificial respiration.

There is another type of respirator. It is a rubber bag which may be strapped round the patient, and by means of a pump it is alternately inflated and deflated. The effect is the same, the nursing of the patient however when the rubber bag is applied is more convenient than the box apparatus.

# CHAPTER XXVIII

AFFECTIONS OF THE LOWER MOTOR NEURONES, *continued.* NERVE INJURIES :—Classifications—Nerve suturing—Sensory and trophic changes—Principles of physical treatment—*Upper extremity*—Injuries to the brachial plexus—Erb's paralysis—Injuries to Median — Ulnar — Circumflex — Musculo-spiral nerves — Crutch paralysis — Drunkard's paralysis — *Lower extremity* — Injuries to Anterior crural—Obturator—External popliteal nerves.

## NERVE INJURIES

As the result of serious injury nerves may be damaged in several ways.

Professor Seddon has classified nerve lesions as follows :—

1. *Neurotmesis.* An anatomical division of a nerve and all its elements. All conduction is lost. Reaction of degeneration appears in about 15 to 19 days.

2. *Axonotmesis.* The axons have been injured enough to cause their death and degeneration, but the fibrous supporting structures remain intact. Reaction of degeneration is present, but the axons grow down their former channel and recovery may be expected.

3. *Neuropraxia.* A physiological lesion due to pressure or trauma. Conduction is interrupted, but there is no degeneration. Complete recovery takes place.

When a nerve is severed as in neurotmesis the fibres distal to the lesion rapidly degenerate, and at the same time the cells of the sheath of Schwann increase in number. In a short time they are the only remaining part of the fibre left, for the axon and the myelin sheath have broken up and disappeared. The cells of Schwann are very important in the process of regeneration. They are multiplied at the distal end of the cut nerve, and when the new axons grow down from the central stump, they are conducted along their path towards the periphery by the new Schwann cells or neurilemma

A severed nerve requires suturing, but this is not usually carried out for some weeks after the original wound of the injury has healed. During this time of healing end bulbs grow at the cut ends of the nerve, and these may be felt through the skin. The end-bulbs may be widely separated, but sometimes they are joined by a few strands of fibrous tissue.

When the surgeon operates he removes the end-bulbs and other degenerate substance, he exposes healthy nerve tissue, and draws together the cut ends of the nerve trunk. After suturing, the new axons begin to grow, but they only proceed on their way at the rate of 1·5 mm. a day.

"The muscles supplied by the nerves are gradually re-innervated one by one in fairly regular anatomical order."

When neurotmesis is present, there are sensory and trophic changes as well as motor symptoms.

*Sensory changes* show loss of sensibility to light touch and feeling of pain. There is also loss of deep sensibility (known as joint sense).

*In trophic changes* the skin becomes dry, glossy and cold.

The physiotherapist is, however, the most concerned with the motor function, and before beginning treatment must note the following in the affected muscles :—

If movement is nil.
If there is a flicker of contraction.
If there is movement when gravity is eliminated.
If there is movement against gravity.
If there is movement against gravity + resistance.
Has full power returned ?

A chart can be made and the above points noted at regular intervals.

*Physical Treatment.* The postural treatment is very important. The limb is supported on a splint or other apparatus, so that the paralysed muscles are fully relaxed, and the healthy opponents are prevented from contracting.

The limb should be kept warm. Woollen garments or cotton wool is used.

Massage is given daily to improve nutrition, but should not be too prolonged as the muscles are easily fatigued. Gentle muscle kneading and friction round the joints may be given. The region of the suturing must be avoided.

*Passive Movements.* All joints should be gently put through their full range of movements once at each treatment.

*Re-education* then begins, and is the most important part of the treatment. This consists in first teaching the patient muscle contraction, and later how to attempt small active movements. All must be carried out in the best possible position.

The physiotherapist must explain to the patient what he is to do, and teach him first to practise on the good limb, also she must watch with care and patience for the early signs of movement in the affected muscles. A paralysed muscle must first be given the very minimum amount of work possible to do as it is easily fatigued, but day by day the patient is urged to try the contractions and small movements. As power returns the movements are increased in range and strength. The position of the limb is always important as gravity " helps or hinders " as explained on p. 65. By degrees static holdings are tried, and later eccentric and concentric work is given.

In the case of a mixed nerve lesion, the patient should be warned against burning or scalding the parts where sensation is lost.

The student is referred to Chapter VIII for further details of re-education methods, and we now proceed to consider the principal nerve injuries separately.

## The Upper Extremity

### INJURIES TO THE BRACHIAL PLEXUS

Injury to the brachial plexus may be the result of violent traction of the arm during an accident : it may take place when a dislocated shoulder is reduced, or be the result of gun-shot and other wounds. The whole or part of the plexus may be damaged. If the former there is complete paralysis of the upper limb, combined with loss of sensation up to the shoulder. In the latter, the condition will vary according to which nerve roots have received injury, and some of these must now be considered.

**Erb's Paralysis.**—When some of the spinal nerves forming the brachial plexus are injured the fifth cervical root and sometimes part of the sixth are affected. The muscles gaining their nerve supply from those roots become paralysed, and those commonly affected simultaneously are deltoid, biceps, brachialis anticus, and supinator longus. Sometimes the spinati and supinator brevis are also involved.

The causes are: injury, rheumatic neuritis, or pressure by a tumour. It is also seen in newly born children, as it occurs after pressure with the forceps on the brachial plexus during delivery or in breech presentations from severe traction on the shoulder.

*Symptoms.* In both forms there is loss of power immediately after injury. The humerus hangs straight down, and when lifted drops like a flail. It is adducted and rotated inwards. The elbow is kept extended and the forearm pronated. The patient cannot flex the elbow or supinate the forearm.

*Treatment.* The limb is placed on a splint and fixed in the following position. The arm is abducted and externally rotated at the shoulder. The elbow is flexed to a right angle and the forearm supinated. The wrist is extended.

*Massage and movements* are given and during the early stages of treatment the above position must be maintained.

*Re-education.* Each muscle group must be carefully watched for returning power, and small active movements attempted. These should first be done in lying position, and the limb supported on a re-education board so that (*a*) gravity assists, (*b*) gravity is eliminated, (*c*) slight resistance is given. As power returns, the physiotherapist devises simple double-sided exercises (see " Re-education," p. 65).

**Injury to the Median Nerve.** Often caused by cuts, fractures, gun-shot wounds, etc.

It must be remembered that the nerve supplies the following muscles: All the superficial flexors of the forearm, except flexor carpi ulnaris. Its branch, the anterior interosseous nerve, supplies the deep flexors of the forearm except the inner half of flexor profundus digitorum. It also gives branches to some of the thumb muscles, and the first and second lumbricales.

The sensory branches supply the palmar surface of the thumb, the index and middle fingers, and half the ring finger. These branches also extend to the dorsal surface of the same fingers to a little below the level of the nails.

When the nerve is injured, some or all of the following symptoms may be present: Loss of flexion of the second phalanges of all the fingers. Loss of flexion of the terminal phalanges of the middle and index fingers. The thumb cannot be flexed or opposed, and is maintained in a position of extension and adduction. Loss of pronation of the hand (except the amount performed by brachio-radialis).

Sensation is lost or impaired in the regions of the hand mentioned above as supplied by the nerve.

*Note.* Although flexion of the wrist may be impaired, this movement can still be performed by muscles supplied by the ulnar nerve.

*Massage.* The whole arm is treated, but special attention given to the following :—

Muscles on the anterior surface of the forearm and hand. The thenar eminence, and the palmar surface of the thumb, index and middle fingers. Running vibrations down the course of the nerve are used.

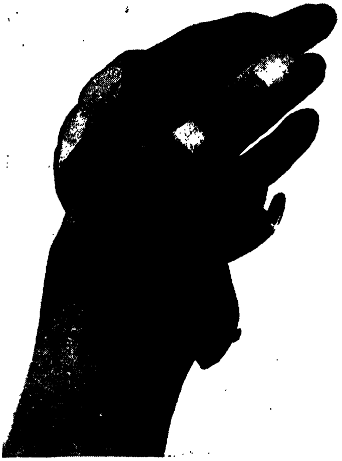

FIG. 139.—SPLINT FOR MEDIAN NERVE INJURY.
*From "Surgery of Modern Warfare," Bailey.*
*By permission of E. & S. Livingstone.*

*Passive Movements.* All joints of shoulder, elbow, radio-ulnar and fingers and thumb.

The wrist must be moved with care and no over-stretching of flexors allowed.

If scar tissue, adhesions, or contracted tendons are present, extra frictions and passive movements must be given.

Flexion of the index finger, and flexion and abduction of the thumb require special attention.

*Re-education.* The limb is placed on a re-education board and *active* movements attempted. Elbow flexion and extension. Pronation and supination. Wrist flexion and extension in inner range only at first. Radial and ulnar flexion. All finger and thumb movements are attempted, and as power returns various small actions are devised. Grasping a ball, crushing paper in the hand. Piano-playing movements. (See " Re-education," p. 65.)

**Injury to the Ulnar Nerve.** Owing to its superficial position at the elbow and wrist, the ulnar nerve is very liable to injury.

It supplies the following muscles: Flexor carpi ulnaris, the inner half of flexor profundus digitorum. Its deep palmar branches supply all the interossei, and the two inner lumbricales as well as those forming the hypothenar eminence, and a muscle which adducts the thumb.

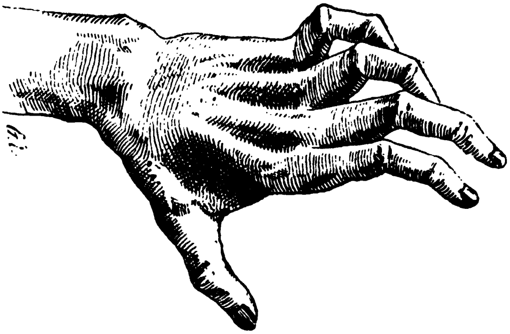

FIG. 140.—CLAW-HAND FROM ULNAR PARALYSIS.

*By permission, from Rose & Carless's " Manual of Surgery " (Baillière, Tindall & Cox, London).*

The sensory branches supply both palmar and dorsal surfaces of the ulnar border of the hand, both surfaces of the little, and half the ring fingers.

When the nerve is injured, some or all of the following symptoms may be present: Loss of power of ulnar flexion of the wrist, as flexor carpi ulnaris is paralysed. The hand is consequently drawn to the radial side. The interossei are paralysed, therefore it is impossible to spread out the fingers, and the dorsal and palmar surfaces of the hand appear wasted. The fingers, specially the ring and little fingers, cannot be flexed at the metacarpo-phalangeal joint, or extended at the inter-phalangeal joints. This is also because of paralysis of the interossei. The opposing muscles continue to work, and in consequence the hand assumes a typical "claw shape."

There is loss of power of flexion in the little and ring fingers, and the thumb cannot be adducted. The muscles of the hypothenar eminence become wasted. Sensation is lost or impaired in the region of the hand supplied by the nerve as given above.

*Treatment.* The position of rest should include flexion of the elbow and wrist. The thumb should be adducted across the hand, the fingers flexed at the metacarpo-phalangeal joints and extended at the inter-phalangeal joints. The hand should be supported midway between pronation and supination. A special splint is worn to maintain these positions at the various joints. It may be removed during treatment, but the position of the hand should be maintained as far as possible.

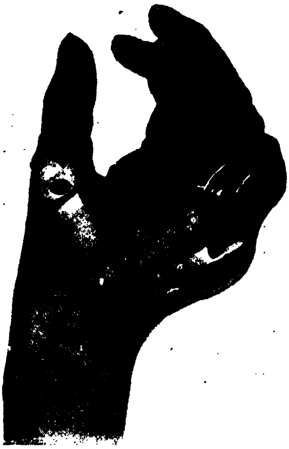

FIG. 141.—SPLINT FOR COMBINED MEDIAN AND ULNAR PARALYSIS.

*From "Surgery of Modern Warfare," Bailey.*
*By permission E. & S. Livingstone.*

*Massage.* The whole arm is treated, but special attention given to the following: Flexor muscles on the ulnar border of the forearm, the palmar and dorsal interossei, the hypothenar eminence, and both surfaces of the ring and little fingers. Running vibrations down the course of the nerve are used.

*Passive movements* to shoulder, elbow and radio-ulnar joints; also to the wrist and fingers, watching for contractions of the ring and little fingers.

*Re-education.* The limb is placed on re-education board and *active* movements attempted. Elbow flexion and extension.

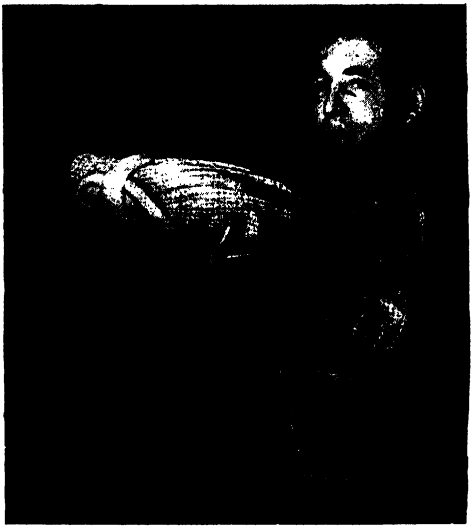

FIG. 142.—ABDUCTION SPLINT FOR PARALYSIS OF ABDUCTORS OF SHOULDER.

*From "Surgery of Modern Warfare," Bailey.*
*By permission of E. & S. Livingstone.*

Pronation and supination. Wrist flexion and extension. Ulnar flexion. Movements in all the finger-joints, but those requiring special care are flexion in the metacarpo-phalangeal joints and extension in the inter-phalangeal joints of the ring and little fingers. Abduction and adduction of the fingers and thumb must also be done to work the interossei and lumbricales (See " Re-education," p. 66.)

**Injury to the Circumflex Nerve.** On account of its position round the surgical neck of the humerus this nerve often becomes involved in fractures of the bone and dislocations of the shoulder-joint. Such injuries cause paralysis of the deltoid muscle, and there may be loss of sensation of the skin covering the shoulder-joint.

*Treatment.* The arm is placed on an abduction splint, and this position must be maintained continuously until some power returns. The limb must be washed daily without altering the position.

*Massage* of the shoulder and upper arm is given at first on the splint, later supported on a pillow.

*Re-education.* All *active* movements should be maintained in the elbow, wrist and hand. When returning power is seen in the deltoid muscle, contractions are taught and small active movements. These are gradually increased and eventually given concentrically and eccentrically in the inner range of movement.

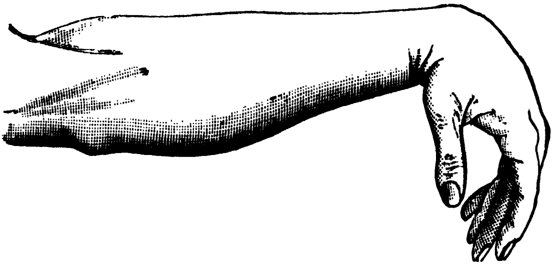

FIG. 143.—WRIST-DROP.

*By permission, from Rose & Carless's "Manual of Surgery" (Baillière, Tindall & Cox, London).*

**Injury to the Musculo-spiral (Radial) Nerve.** This nerve is more liable to injury than any other nerve in the arm. When paralysed it produces the condition known as "wrist-drop." The nerve lies close to the humerus in the musculo-spiral groove, and it is here that it may be torn, or involved in the callus of a fracture. It is also liable to bruises from its exposed position, and it may be cut when a wound is made in the arm.

The nerve supplies the following muscles: Triceps, Anconeus, Brachio-radialis, Extensor carpi radialis longior, and Brachialis anticus. In front of the elbow the nerve divides into the posterior interosseous and radial nerves. The posterior interosseous passes again to the back, piercing the fibres of the supinator brevis muscle. It continues down the back of the forearm, and supplies all the muscles on the radial side and the back of the forearm except anconeus, brachio-radialis, and extensor carpi radialis.

The sensory branches of the musculo-spiral nerve supply a considerable area on the back of the arm.

The radial nerve is purely sensory. It supplies that part of the posterior surface of the wrist, hand, fingers, and thumb which is not supplied by the ulnar and median nerves, viz., the back of the hand, thumb, index and middle fingers and half the ring finger.

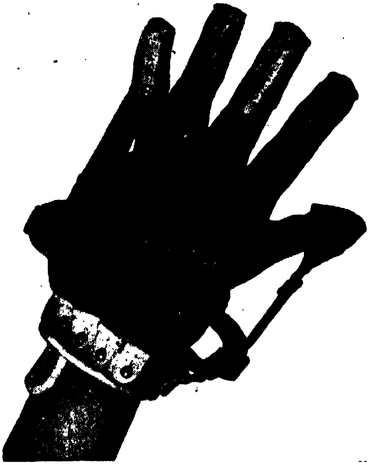

FIG. 144.—SPLINT FOR RADIAL NERVE PARALYSIS.
*From "Surgery of Modern Warfare," Bailey,*
*By permission of E. & S. Livingstone.*

When the musculo-spiral nerve is paralysed, the hand is flexed at the wrist and lies flaccid. The fingers are flexed, and if an attempt be made to extend them, only the two last phalanges will move, and this occurs through the action of the interossei muscles. It is impossible to extend the wrist.

If the arm is extended, supination is lost ; if it is flexed, the movement can be done by Biceps. If the nerve lesion is high up, extension of the elbow is impossible because triceps is paralysed.

*Treatment.* The position of rest is one of abduction at the shoulder joint, and extension of the elbow. The forearm is placed midway between pronation and supination, and the wrist is hyper-extended. The thumb and fingers are fully extended. This position is maintained by a splint. In some cases it is only necessary to keep the wrist in extension when a small " cock-up " splint is applied.

*Massage* is given to the whole arm, with special attention to :—Triceps, Brachio-radialis, and all the extensor muscles of the forearm. The back of hand and fingers. Running vibrations down the course of the nerve are used.

*Passive Movements.* May be given in all joints of the arm, but care must be taken not to stretch the wrist extensors.

*Re-education.* The forearm is supported on a re-education board, and *active* movements of the wrist and hand are attempted. Wrist extension (*a*) the hand lying supine over the edge of the support (gravity assisting) ; (*b*) the hand is held between pronation and supination (gravity eliminated) ; (*c*) the hand is pronated (gravity resisting). Extension in the metacarpo-phalangeal joints are attempted in the same positions, the physiotherapist fixing the wrist with her hand.

When power has returned the splint is discarded during the day, but should be worn at night for some time longer.

Later, exercises are devised for the wrist and fingers and the usual active movements given to the shoulder and elbow.

**Crutch Paralysis.** Caused by the pressure of a crutch on the brachial plexus in the axilla. The musculo-spiral nerve is the one most frequently involved.

This is often the type of lesion known as neuropraxia (see p. 360). Though the motor paralysis is complete for a time, it usually clears up again. The electrical reactions remain unchanged.

*Treatment.* As soon as this condition is noticed, the crutch must be discarded or used as little as possible or an elbow crutch is substituted. Sometimes the wrist is placed on a " cock-up " splint.

Massage of the hand and forearm are given as for musculo-spiral paralysis and re-educated in the same way.

**Drunkard's Paralysis.** The result of pressure on the brachial plexus, which takes place while the patient is in a profound sleep, and under the influence of alcohol ; *e.g.* a man who falls asleep with his arm hanging heavily over the back of a chair.

The musculo-spiral is again the nerve usually affected.

*Treatment.* The same as described above. Recovery may not occur for weeks, and much patience and perseverance in re-education is required.

## INJURIES TO NERVES OF THE LOWER EXTREMITY

**Anterior Crural Nerve.** This nerve is sometimes injured, but it is more frequently paralysed as the result of infantile paralysis.

It supplies the muscles on the front of the thigh, and when paralysed flexion at the hip is incomplete, because iliacus is affected. Extension of the knee is lost because the quadriceps femoris is paralysed. Sartorius and Pectineus are also affected.

*Treatment.* It may be necessary for the patient to rest in bed, when the limb is placed on a splint, or he lies in a specially made plaster case, fitting from the hip down to the foot. Others may be allowed to walk in a splint which keeps the knee fully extended.

*Massage* of the whole limb giving special attention to paralysed muscle groups. Movements are given to prevent stiff joints.

*Re-education.* Muscle contractions must be learnt and small *active* movements encouraged in the most favourable positions. If a swimming pool is available, the patient is placed in it and taught to move (see p. 66). The water is a great help in maintaining the weight of the limb.

As power returns active movements must be practised daily, carrying out the principles given in Chapter VIII.

**Obturator Nerve.** This nerve supplies the knee-joint. It also gives a branch to the hip, and in the early stages of tubercular hip disease the patient complains of pain, not in the hip itself, but on the inner side of the knee and in the joint. This is due to the obturator nerve supplying both joints.

Massage is unsuitable in such cases, but might be given when the nerve is paralysed with others in its neighbourhood, *e.g.* for infantile paralysis.

**Injury to the External Popliteal Nerve.** The external popliteal nerve is liable to injury from blows, cuts, wounds, etc., owing to its exposed position. When the muscles it supplies are paralysed, the condition known as "foot-drop" is produced.

The nerve is a branch from the great sciatic. The latter divides in the popliteal space, and its smaller branch, viz., the external popliteal, passes out towards the head of the fibula. Behind this prominence the nerve can be felt beneath the skin. It then winds round the neck of the bone and passes down the leg. It soon divides into two branches, the anterior tibial and the musculo-cutaneous nerves. Before dividing, the nerve gives a sensory branch to the region of skin on the outer side of the knee, and also a branch to the joint.

The anterior tibial nerve passes down the front of the leg, lying between the tibia and fibula. It supplies tibialis anticus, extensor longus digitorum, peroneus tertius, and extensor proprius hallucis. A small branch also goes to extensor brevis digitorum.

The musculo-cutaneous nerve gives the supply to peroneus longus and brevis, and the sensory supply to a large area down the anterior aspect of the leg and foot.

When the above-mentioned muscles are paralysed, dorsal flexion of the ankle and toes, also eversion of the foot, are impossible. Talipes varus sometimes results from this condition.

*Treatment.* A splint is applied to keep the foot at a right angle, and so prevent foot-drop. Sometimes this is worn only at night, and by day the patient has a spring appliance on his boot which holds the foot up and enables him to walk better.

*Massage* is given to the lower leg and foot, paying special attention to the dorsi-flexors and the peronei muscles.

*Re-education* of the paralysed groups must be continued for a long time.

At first the patient is placed in forward lying, or kneeling on a chair, his foot over the edge of a couch or chair: (*a*) he attempts dorsi-flexion (gravity assisting); (*b*) in side-lying with foot on a re-education board; dorsi-flexion and eversion are attempted (gravity eliminated); (*c*) in long sitting, the movements are repeated (against gravity). As power returns in the muscles, static eccentric and concentric work is added.

Later, standing and walking exercises are devised.

Throughout the treatment the physiotherapist must watch for any signs of over-activity in non-paralysed groups which might cause deformity.

When the patient is in bed, the weight of the bed-clothes should be taken off the foot.

# CHAPTER XXIX

AFFECTIONS OF THE LOWER MOTOR NEURONES, *continued* :—DISEASES OF NERVE TRUNKS—Neuritis and neuralgia—Cervico-brachial neuritis or neuralgia — Sciatica — Coccydynia — Metatarsalgia — Intercostal neuralgia—Tri-geminal neuralgia—Tic douloureux—Facial paralysis or Bell's palsy—Post-diphtheritic paralysis.

## DISEASES OF NERVE TRUNKS

### NEURITIS AND NEURALGIA

"NEURITIS is inflammation of a nerve, or of the fibrous sheath of a nerve" (*Bastian*).

This condition appears when a patient is in a lowered state of health. It may also be caused by cold, injury, pressure from inflammatory products, gout, rheumatism, kidney disease, diabetes, alcoholism, and some forms of poisoning.

There is pain and tenderness along the course of the nerve trunk and its branches. The nerve is sometimes swollen and can be felt. There is atrophy of the muscles of the affected part, and much weakness of the limb. Sensations may be increased or diminished. If the inflammation is in the nerve substance, symptoms of paralysis may be present.

Neuralgia is pain in the course of a nerve and its branches. The causes and symptoms are much the same as in neuritis, but less severe. The pain occurs in attacks and is seldom continuous.

*Treatment.* The patient's general condition requires attention. Rest is essential for the affected part.

Massage, when ordered for neuritis, must be administered with great care, and not until acute symptoms have subsided somewhat.

### CERVICO-BRACHIAL NEURITIS OR NEURALGIA

"The nerves of the brachial plexus and the posterior branches of the four lower cervical nerves are here concerned" (*Buzzard*).

There is pain in the neck and shoulder region, as well as down the course of one or more of the nerve trunks of the arm.

Tender and painful spots are found :—

Over the brachial plexus in the posterior neck triangle.

In the axilla and over deltoid.

In the course of the following nerves :—

The ulnar, as it passes between the olecranon and the internal condyle of the humerus.

The median in the anti-cubital fossa.

The musculo-spiral on the back of the arm, as the nerve leaves the musculo-spiral groove.

The radial, at a point where the nerve becomes superficial.

*Treatment.* Much rest is required. The patient may be kept in bed at first. The arm must be supported by a large sling, to bear the weight of the limb. Warmth is essential, and a shoulder cap and sleeve of gamgee tissue may be worn, or a covering of thermogene wool.

When physiotherapy is ordered, anodal galvanism is given. Radiant heat or infra-red may be used, and very gradual massage and movements are added.

Reflex stroking of the whole limb. Flat-handed vibrations, beginning over the brachial plexus and continuing down the arm.

Effleurage may be tried, but may prove painful in the early stages. If the patient complains, vibrations should be given instead.

Later gentle muscle kneading and finger-tip kneading down the course of the nerves, also running vibrations. These manipulations are given to overcome adhesions which are the product of inflammation in the nerve sheath.

Mobility of the limb must be maintained, and when pain has ceased, active movements are added to strengthen the muscles.

## SCIATICA

Sciatica is pain of varying degree along the course of the sciatic nerve.

It may be of neuralgic origin, or an inflammatory state of the nerve sheath and its surrounding tissues.

In recent times it has been proved that the condition is frequently caused by the protrusion of an intervertebral disc, resulting in pressure upon the lumbar nerve roots. The nerve trunk is stretched by passing over the disc.

Neurologists who have made extensive investigations say that 95 per cent. of the cases of sciatica pain are due to disc protrusion.

Owing to war conditions when both men and women undertook heavy occupations, *e.g.* carrying weights to which they. were unaccustomed, many of them sustained prolapsed discs

Other causes of sciatica may be :—

Pressure from a tumour on the cauda equina. Disease of the ovaries and uterus. Carcinoma of the rectum, osteo-arthritis in the intervertebral joints, also rheumatism or fibrositis.

"Fibrositis and allied myofascial conditions are probably responsible for involvement of the nerves after they have emerged from the vertebral column. There is little evidence that inflammation of the main trunk of the nerve is a cause of sciatica" (*Holmes and Sworn*).

*Symptoms.* These depend on the cause, and the part of the nerve affected. There is often pain in the lumbar region which extends down the leg. There may be marked muscle wasting, and loss of dorsi-flexion in the ankle. Pain may come on suddenly or gradually. It is often very severe especially at night. It is sometimes intermittent, but in many cases it is continuous. It is increased by coughing, sneezing or by other strain. After a time there may be reaction of degeneration in the nerve.

On palpation thickening may be felt in the muscles, and tender points are found along the course of the nerve in the following regions :—

1. As it passes out of the sciatic notch.
2. Midway between the tuberosity of ischium and the great trochanter, just below the gluteal fold.
3. As the nerve passes from under the Biceps muscle, half-way down the thigh.
4. In the popliteal space.
5. In the middle of the calf.
6. Midway between the inner malleolus and the lower border of the foot.
7. In the centre of the sole of the foot.

*Treatment.* Complete rest in bed is essential If there is a prolapsed disc the recumbent position must be maintained for at least 6 weeks. It is very desirable that the patient should be nursed in hospital, for on no account may he or she get out of bed. Standing, also sitting and straining on a night-stool may increase or renew the trouble.

The patient is allowed to assume his most comfortable position, which is probably lying on his side with his hips and knees slightly flexed.

If no disc lesion has been diagnosed the strict conditions may be modified.

When physiotherapy is allowed, some form of heat is applied, viz. radiant heat, infra-red or Pistany mud applications.

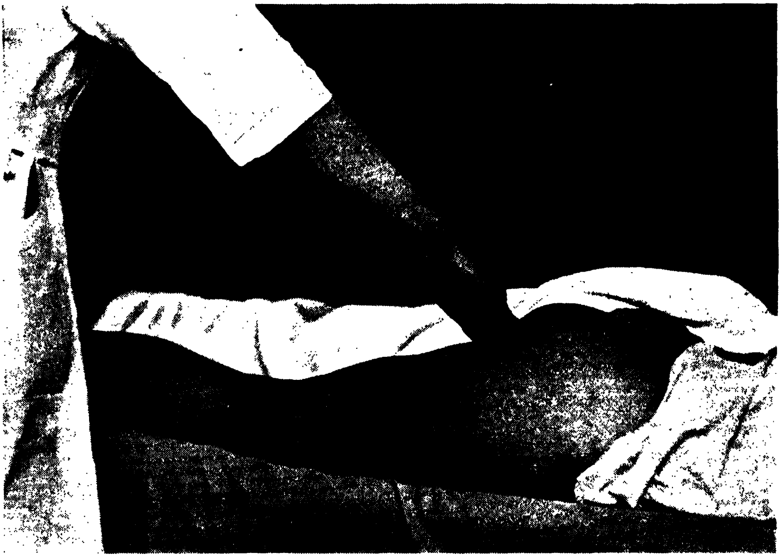

FIG. 145.—KNUCKLE-FRICTIONS OF THE SCIATIC NERVE.

Anodal galvanism is often given with good results, and sometimes saline injections, or histamine treatment is ordered.

In disc cases very early active movements are usually prescribed.

Massage is never given until the acute stage has passed. When ordered, it must be very gentle, and be gradually increased in strength and amount.

The patient should lie prone, but if this is not possible he lies on his side.

The lumbar and gluteal regions are treated with much effleurage, flat-handed vibrations and later friction and kneading.

The back of the leg and thigh then receive long, slow strokes of effleurage from the foot to the gluteal fold. Flat-handed vibrations over all the painful areas. Running vibrations down the nerve with finger-tips. Friction with finger-tips gradually increasing the depth. They help to remove adhesions and inflammatory products in the nerve sheath.

The knuckles are sometimes used for very deep friction. All the muscles require kneading and petrissage, and to finish, more long deep strokes of effleurage are given.

By degrees movements are added in all the joints.

The above scheme requires modification according to the strength and condition of the patient. At the beginning it is often well to give no movements. The patient is often unable to bear effleurage, and when this is the case vibrations must be used instead. Later, when improvement is maintained, stationary nerve pressures may be added.

When the patient is convalescent exercises may be done such as :—

Half-yard grasp standing, leg swinging.
Lying, alternate leg lifting.
Reach grasp standing, heel raising.
Wing standing, trunk bending forwards and downwards.
Marching in spaces to rhythm to overcome any limp.
Fix heel in bars, trunk bending forward.

### COCCYDYNIA

Coccydynia is neuralgic pain in the region of the coccyx. It may be caused by fracture or displacement of the bone, or by diseases of organs and structures in its neighbourhood.

Massage may be given if the pain is of neuralgic origin. At first it should be soothing, but the strength should be gradually increased. Effleurage, vibrations, and friction are given over the painful areas.

Rectal diathermy or short-wave treatment may be ordered.

### METATARSALGIA

Metatarsalgia is neuralgic pain in the feet, in the region of the heads of the metatarsal bones. The pain may extend up the limb.

The condition is seen in gouty and rheumatic subjects, or is caused by injury. It may occur with flat foot.

It is probably due to compression of the nerves of the foot between the heads of the metatarsal bones and the ground. Corns often appear on the sole of the foot. The pain is increased by walking, and occurs in characteristic attacks.

Massage of the feet and legs does much to alleviate the condition. Passive stretching with active movements should be given, specially plantar flexion of the foot and toes given concentrically and eccentrically. Raising on to the outer borders of the feet should also be done as a free exercise, first in sitting and later in standing position.

Faradic foot baths are used and give great relief.

## INTERCOSTAL NEURALGIA

Neuralgia may be present in any of the dorsal nerves. The pain, which occurs at intervals, is confined to one side, generally the left.

The condition may be caused by cold, rheumatism, overstrain, disease of the vertebræ, etc.

*Symptoms.* There is pain in the course of the nerves, more frequently in the front and sides than at the back. There is often pain when breathing or coughing. There may be tender points close to the spine, sternum, and in the mid-axillary line.

*Treatment.* Some form of heat may be applied and anodal galvanism. Massage of the back and chest. Much effleurage and vibration should be given over the painful areas. Running vibrations and friction over the nerves and intercostal muscles. Gentle muscle kneading.

## TRI-GEMINAL NEURALGIA OR NEURITIS. TIC DOULOUREUX OR NEURALGIA OF THE 5TH CRANIAL NERVE

The tri-geminal is the largest of the twelve cranial nerves. It has three branches, hence its name. They are: the ophthalmic, the superior maxillary, and the inferior maxillary.

Sometimes one and sometimes two of these branches, but rarely all three together, are affected with neuralgia. The pain is very severe, and usually occurs in paroxysms. It is often preceded or followed by neuralgia in other regions, especially in that of the occipital nerve. This condition may be combined with rheumatism of the neck muscles.

If the ophthalmic branch is affected, there is tenderness over the supra-orbital notch, and pain over the forehead and scalp, also round the eye and nose.

If the superior maxillary is affected, there is tenderness at the infra-orbital notch, and in the region of the malar bones.

If the inferior maxillary is affected, there is tenderness at the dental foramen, pain over the parietal and temporal bones, and in the region of the ears, lower jaw, and tongue.

*Treatment.* Neck massage. The patient sitting, leaning slightly forwards, and having her head supported :—

Effleurage, vibrations, and friction specially of the great occipital and great auricular nerves if affected. Gentle kneadings of muscles.

The front of the neck and throat. The patient sitting, the masseuse standing behind :—Much effleurage over the jugular veins.

The face. The patient sitting with head well supported :—

Effleurage over the course of the veins. Stroking, vibrations, and friction over all the affected nerves. Much soothing, stroking over all the face. Friction of the scalp may also be given in some cases.

*Note.* A stationary pressure on a nerve will sometimes relieve pain, but the whole treatment is usually given between the attacks of pain.

Anodal galvanism is sometimes beneficial.

## FACIAL PARALYSIS OR BELL'S PALSY

Bell's palsy is due to paralysis of the 7th cranial nerve, resulting generally in paralysis of one half of the face. Both sides are seldom affected. It is caused by exposure to cold, shock, pressure, fracture of the base of the skull, operation for mastoid abscess, etc.

The 7th cranial nerve has both motor and sensory branches.

The motor part supplies the muscles of expression of the face, the scalp, the pinna of the ear, Buccinator, Platysma, the Stylo-hyoid, and the posterior belly of the Digastric muscle.

It also contains some fibres which constitute the vaso-dilator nerves of the sub-maxillary and sub-lingual glands.

The sensory part contains some fibres of taste to the tongue.

*Symptoms.* The wrinkles on the skin become less marked on the affected side. The eyelids cannot be brought together. (The eye remains open during sleep.) In smiling, the lips are displaced to the healthy side. The nostril on the affected side cannot be dilated. Food accumulates between the jaw and cheek, owing to the relaxation of buccinator. The naso-labial fold is less marked on the affected side. Whistling is impossible, owing to paralysis of half the orbicularis muscle. The condition comes on in a few hours, or it may take three or four days. In cases which recover, some return of power takes place in from a week to two months. Improvement generally begins in the upper part of the face.

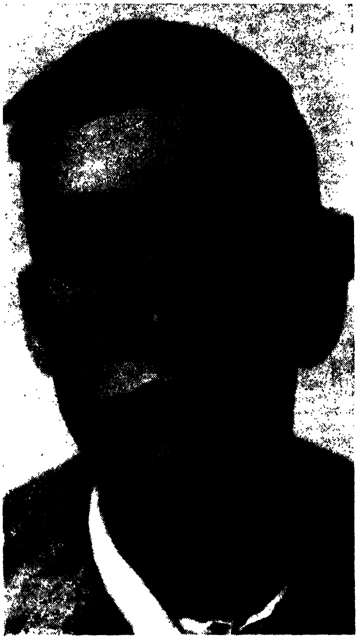

FIG. 146.
Face in repose.

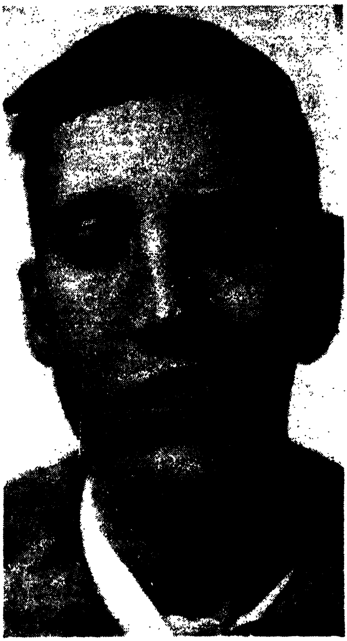

FIG. 147.
Smiling.

FACIAL PARALYSIS.

*Treatment.* The manipulations must be of a stimulating nature. Effleurage, friction, vibrations on the affected side of the face, specially over the course of the nerve as it passes out of the stylo-mastoid foramen. (There may be tenderness where it emerges from the foramen.) Kneading and picking up of cheek muscles, and frictions, the masseuse placing one or two fingers inside the patient's mouth for some of the frictions. Hacking. Effleurage and gentle friction on the eyelid.

Interrupted galvanism is given, and a small splint worn. The splint is of wire covered with rubber and inserted into the corner of the mouth on the affected side. The wire is held by curving it over the ear.

### POST-DIPHTHERITIC PARALYSIS

Paralysis is a common complication of diphtheria. It usually appears two or three weeks after the fever has subsided, but the time of its onset is variable. Older patients are more liable to become paralysed than young ones.

The soft palate is the first part affected usually, and then the eyes. Later the limbs are attacked, generally the legs first, and then the arms. The patient complains of tingling feelings, " pins and needles," or actual pain in the parts attacked, and then the paralysis comes on slowly. It is not often complete, but enough to make the muscles useless. The muscles are flaccid, and soon begin to waste. All reflexes are lost. There are changes in sensation. Almost every part of the body may be attacked. Sometimes the intercostal muscles and the diaphragm are affected, so that respiration becomes difficult or impossible.

Generally the paralysis recovers in one part while it progresses in another, and as a rule it does not return to a part which it has left.

The average time for the paralysis to last is 6 to 8 weeks, but it may continue in the limbs for from 4 to 6 months.

*Treatment.* Rest in bed, until definite improvement is seen. If massage is ordered, it should be applied gently to the affected muscles ; chiefly effleurage and muscle kneading to improve nutrition, and passive movements to help the circulation. The patient should not be over-tired.

# CHAPTER XXX

AFFECTIONS OF THE SENSORY TRACTS:—Locomotor Ataxy. AFFECTIONS OF BOTH MOTOR AND SENSORY TRACTS:—Chronic transverse myelitis—Friedreich's ataxia.

## AFFECTIONS OF THE SENSORY TRACTS

### LOCOMOTOR ATAXY OR TABES DORSALIS

"A DISEASE of the spinal cord alone, or of the spinal cord and peripheral nerves; manifested when considerable, by inco-ordination of movement, peculiar pains, defective sensibility, and loss of muscle reflex action" (*W. R. Gowers*).

Men suffer more frequently from this disease than women. It is nearly always a result of syphilis. Only a small proportion of cases are known to have arisen from other causes. The condition appears at a variable time—1 to 20 years after the patient has been first affected by syphilis.

"There is sclerosis of the posterior columns of the spinal cord and the posterior nerve roots. There are also changes in the peripheral sensory nerves" (*Hudson*).

*Symptoms.* These are divided into three stages:—

*Stage I.* There are changes in sensation—lightning pains in feet and legs; "girdle sensations"—like a constricting band round the waist. The knee-jerks are lost. The pupil reflex to light is lost.

*Stage II.* Called the ataxic stage. All the previous symptoms are present. A characteristic gait is developed with loss of co-ordination of movement. The patient lifts his legs too high, throws them out and stamps when putting his foot to the ground. He has a sense of walking on cotton-wool, no sense of balance, and he cannot walk in the dark. Other symptoms develop later, one of these being a swelling of the joints. The knee is often affected, it becomes swollen, filled with fluid, and finally undergoes changes resembling those of osteo-arthritis. This is known as a Charcot's joint.

*Stage III.* All the symptoms increase. The patient becomes paralysed and totally bed-ridden.

The disease lasts for many years; death usually takes place due to some cause such as pneumonia or tuberculosis.

*Treatment.* The symptoms may be relieved by massage and exercises. The general circulation and the nutrition of the nervous system may be much helped.

Muscle kneadings, nerve vibrations, and friction may be given. Special vibrations down the spine. Abdominal treatment is often beneficial.

Frënkel's Exercises are specially arranged in a system for patients suffering from locomotor ataxy, and if regularly carried out are very helpful.

## AFFECTIONS OF BOTH MOTOR AND SENSORY TRACTS

### INFLAMMATION OF THE SPINAL CORD: CHRONIC TRANSVERSE MYELITIS

Transverse myelitis is inflammation of the spinal cord, affecting a whole transverse section of the cord.

In the chronic form the nerve tissue is replaced by connective tissue. Any part of the cord may be affected, but it is commonest in the dorsal region.

This disease appears sometimes without apparent cause, but it is also due to sudden chills, emotional disturbances, certain acute fevers, inflammation of the pelvic organs, and syphilis.

*Symptoms.* Numbness and tingling in the legs, followed by weakness and later paralysis. Changes in sensation. The reflexes are usually lost at first, and later become greatly increased. The limbs become spastic. The sphincters are involved, and there is incontinence of urine and fæces.

*Treatment.* It is impossible to cure this disease, but symptoms may be relieved by good nursing, suitable diet, and drugs.

Massage may be given to improve the circulation and the nutrition of the nervous system. Effleurage, muscle kneading to the limbs, and passive movements. Only vibrations and soothing stroking should be given down the spine.

### FRIEDREICH'S ATAXIA

Friedreich's ataxia is a nervous disease, which has been described as intermediate between locomotor ataxy and disseminated sclerosis. It seems closely allied to both, though it is more like the latter than the former.

It is a disease of early life, appearing during childhood, and up to the twenty-fifth year. It is not, strictly speaking, an hereditary disease, but several members of the same family are often affected.

" The disease is dependent upon the development of areas of sclerosis in the posterior, and in the antero-lateral columns of the cord, as well as in some parts of the grey matter " (*Bastian*). There are no special causes of the disease.

*Symptoms.* There is gradual progressive weakness in one or both legs, combined with a characteristic gait, like the swaying of a drunken man. Later the weakness extends to the arms, and the movements become tremulous. The knee-jerk is lost, and as the disease progresses deformities arise, such as pes cavus and curvature of the spine. Later other symptoms appear.

The course of the disease is very slow, from 5 to 30 years, but it always proves fatal.

*Treatment.* Nothing is of much avail. Massage may be helpful to keep up general nutrition. Balance exercises to help co-ordination, and the deformities which arise should be counteracted.

# CHAPTER XXXI

NERVOUS DISEASES, *continued*.—Temperament—The nervous temperament—Functional nervous diseases—Neurasthenia—Hysteria—Neuroses—The neurosis of occupation—Writer's cramp—Paralysis agitans.

## TEMPERAMENT

THE study of temperament dates back to very ancient times. It seems that the term when first used denoted the connection between a physical and a mental condition, but at present the word is used in a somewhat vague way to denote mental characteristics only.

The ancients considered two groups of four qualities, viz., hot, cold, dry, moist ; and fire, air, earth, and water. From a mixture or " tempering " of these they devolved the four temperaments found in human beings. They are—the sanguine, the melancholic, the choleric, and the phlegmatic. To these a fifth has been added—the nervous temperament, and it is with this last that we are here mostly concerned.

## THE NERVOUS TEMPERAMENT

The study of temperament is important to those who have charge of nervous patients. The subject is so large that it cannot be fully considered here. There are excellent books which should be studied by those taking up this important branch of nursing, or when treating this class of patient by physiotherapy.

People are often described as " neurotic." This signifies a nervous condition, but the term is often used in speaking of a selfish, irritable patient who cannot get her own way. Care must be taken to distinguish between such a case and a purely nervous one. The nurse and physiotherapist require endless patience, tact, and kindliness. Their influence may have an unbounded power for good, and so help the patient to an early recovery.

## FUNCTIONAL NERVOUS DISEASES

Functional nervous disorders embrace a large group and require very special study by those who undertake their treatment.

Functional disease means a condition where there is no organic change, but it must be remembered that organic change is sometimes present associated with a functional element, and the latter may be the most important point in the treatment.

It is important to study all the symptoms and to explain them to the patient as far as possible. It is a mistake to tell a patient his symptoms are imaginary, but better to show him he is creating something in his mind which other people cannot see.

The symptoms are very varied and may include—defective circulation, muscle tension, fatigue, insomnia, lack of power of concentration, restlessness, etc.

The treatment is also varied. Physiotherapy may be of great value. Where there is muscle tension relaxation exercises are given, and throughout it is important that the patient has much rest.

### NEURASTHENIA

The term " neurasthenia " denotes nervous exhaustion. It is " functional " and is the result of certain changes taking place within the body. These changes so act upon the nervous system that exhaustion is produced. The condition differs widely from hysteria, though sometimes symptoms co-exist. Neurasthenics are often sensible clever people who earnestly wish to be well. It is more common in women than in men, though it is seen in the latter as the result of worry and strain of business, and as the result of war conditions, it has appeared in many forms.

Predisposing causes are: poisons entering the system, *e.g.* those produced by a disordered digestion, over-strain, shock, general ill-health, etc.

Dr. Edwin Ash says: " A great number of neurasthenic people owe their condition, in part at any rate, to chronic disorders of the digestive organs which, through insufficient digestion and absorption of food substances, lead to the production of toxins (that is, poisonous substances) in considerable quantities throughout the intestinal tract, from which they readily gain access to the circulation and thus reach the nervous centres. . . . Mental anxiety and nerve strain quickly upset the digestion, and the digestion being disordered, the absorption of poison quickly follows. . . . Neurasthenic patients suffer much from indigestion and colitis, in both of which conditions the mucous membrane of the various parts of the alimentary canal becomes coated with a thick catarrhal exudate, which prevents the proper action of the digestive juices, and further predisposes to the development of numerous microbes, which in turn contribute yet more poison to the disordered system."

*Symptoms.* These are many and varied. Some or all of the following may be present: a constant feeling of weariness, loss of appetite, dyspepsia, constipation, flatulence, mucous colitis, mental depression, insomnia, poor circulation, headache, and giddiness, combined with a feeling of weight in the head; restlessness and irritability.

*Treatment.* This is varied, according to the condition and circumstances of the patient.

Much rest is essential, good food and fresh air are necessary. A rest cure is sometimes ordered. General massage is given, and should include much effleurage, muscle kneading, and passive movements. These are with a view to helping the circulation and general nutrition. All movements given must be gentle and rhythmical and anything irritating avoided.

Definite symptoms must have special attention, such as constipation, insomnia, or headache.

The physiotherapist must gain her patient's confidence, show understanding and explain the symptoms.

The patient must be allowed to talk, and the physiotherapist must listen and remember the details imparted. It is not wise to promise rapid recovery, but a hopeful attitude must be maintained, and by the use of suggestion much help can be given.

## HYSTERIA

Hysteria is a functional nervous disorder, presenting a variety of symptoms. It must be supposed that the higher centres of the brain lose their control.

Dr. Edwin Ash says: " that it is not that the patient *cannot* or that she *will not;* but, that she *cannot will.* It has been the custom in times past to use the word 'hysteria' in referring to sham illnesses and malingerers, also in reference to young women who are over-emotional, and lacking in self-control. With such as these we are not now here concerned. Everyone to whom the task falls of dealing with hysteria must realise that it is a definite disease. The patient can no more help suffering from it than she could help having pneumonia or appendicitis."

Hysteria is a great imitator, and there is hardly any disease, from paralysis of various parts of the body to tuberculosis of the lungs, which cannot be simulated by patients suffering from this complaint. This being the case, diagnosis is often extremely difficult. Mistakes are often made in both directions, *i.e.* a doctor may diagnose serious organic trouble, which eventually proves not to exist, or he may set down something as hysteria which turns out to be an organic disorder, involving endless suffering to the patient, and even sometimes costing life itself.

Hysterical patients are subject to convulsive attacks resembling epilepsy. They may be preceded by a sense of suffocation, pain in the stomach, headache, and giddiness, and eventually with a cry the patient falls. In hysteria she invariably manages to fall gently without hurting herself, whereas in epilepsy the attack and fall are so sudden, there is often serious injury.

Those who have seen an hysterical attack cut short by such means as slapping in the face with a wet towel are apt to think that the patient objects so strongly that she at once controls herself. But the truth is that the sudden extra stimulus has given the mind and nervous system the impetus it requires to set it right again.

Some hysterical conditions can be proved by means of electricity, *e.g.* certain contractions and deformities. The electrical reactions remain normal when the condition is due to hysteria, whereas if due to paralysis they are altered.

Motor and sensory symptoms often appear, and the digestion is frequently upset.

" Globus hystericus " is a common symptom. The patient complains that a lump like an egg arises from the stomach to the throat. It causes a choking feeling and is often accompanied by an outburst of tears.

" Hysterical aphonia." The patient is unable to use the voice and speaks in a whisper. This is due to a perversion of the will, and the condition may exist for months or years.

" Anorexia nervosa " is a form of hysteria with severe digestive symptoms. The patient loses her appetite and it is only with the greatest difficulty she is persuaded to take food. She becomes emaciated and the skin is hard and dry. With wise and persistent treatment such cases may recover, but they are often unsatisfactory.

*Treatment.* This must vary considerably according to the signs and symptoms which manifest themselves, and also depend upon the general physical and mental condition of the patient.

A rest cure may be ordered, when massage is given. The moral control of the nurse and physiotherapist is a very important factor. Symptoms, *e.g.* constipation, insomnia, and headache, require special attention, and much may also be done for supposed symptoms, *e.g.*, aphonia, which may be treated with vibrations over the larynx ; paralysis, where massage and movements may be applied. Faradism is often given with success in such cases. Change of air and scene is often desirable, and improvement may be gained if the patient is away from her home and relatives.

## NEUROSES

Under the name of " neuroses " are classed certain nervous disorders which occur without any known cause, and without any structural changes being detected in the nervous system.

A variety of neuroses were seen as the result of war conditions. Many were cases after the severe strain of bombing, seeing comrades killed and injured, and undergoing hunger, fatigue and exhaustion. Such experiences often resulted in anxiety states, and hysterical conditions. These produced functional symptoms such as tremors, paralysis, fits, blindness, deafness and aphonia.

These cases come under psychological treatment, but such conditions may be combined with a physical disability which the physiotherapist may be called upon to treat.

### THE NEUROSES OF OCCUPATION

Certain kinds of neuroses are acquired which appear due to the repeated performance of some particular function. The patient complains of inability to execute some act, the performance of which has probably taken him years to learn.

Writer's cramp is the commonest form of this group, and will here be dealt with fully, but similar conditions have been seen, viz., in piano players, who have been unable to strike chords correctly, violinists who have lost the power of holding their instrument and of fingering with the left hand, tailors who could no longer use the needle, compositors who could not place their type, and latterly a similar condition has been seen in typists and telegraphists, who have been unable to carry on their work.

The actual changes which take place when any of the above conditions are present are unknown, but the trouble is said to be due to brain fatigue. It may, however, originate in the brain cortex, the conducting fibres, or the peripheral nerve or muscle, according to the symptoms shown.

### WRITER'S CRAMP

Persons afflicted with writer's cramp are usually of a very nervous temperament.

The condition comes on gradually, and is hardly noticeable at first. The patient, not knowing what is before him, will continue his writing, compelling himself to go on, in spite of aching in the limb and increasing loss of power to write.

The trouble may progress so far that the patient is quite unable to write his name. It is generally observed that the disease progresses from the periphery towards the centre—that the muscles of the fingers are the first to fail, then those of the forearm, then those of the arm, and lastly in extreme cases, the trunk.

The loss of writing power may be the only symptom. The following was the case of a patient who wrote to his doctor: " That fingers which could guide razor and needle, wield oar and musket, and though numb with cold, knot and cast off reef points on a wet sail, should yet strike work when called on for the familiar character of their owner's name, seemed utterly beyond comprehension " (*Poore*).

The performance of other acts is, however, affected in some cases. To test this, the patient should be asked to wind his watch, to carry a full teaspoonful of liquid to his mouth, etc.

*Symptoms.* Inability to perform the acts of writing. Minute movements of thumb and fingers for other actions may or may not be affected. Much fatigue in the hand and arm. There may be pain in the back and headache. Spasms in the muscles when writing is attempted. Often the flexors are spastic and contracted, while the extensors are weak and flaccid. Slight tremors are sometimes present. There is often tenderness of the nerve trunks, viz., the median, ulnar, and musculo-spiral nerves. There is a feeling of numbness and pins and needles. There may be mental distress, and in severe cases paralysis.

*Treatment.* Rest is essential, and if this is taken completely in the early stages, a good result may be expected. For such writing as is absolutely necessary, the patient should be advised to use a pencil, or a soft quill pen, and either should be grasped as lightly as possible. He should try to alter his writing somewhat, and let it be as large as possible.

Massage may be given with great advantage. The whole arm is treated from fingers to shoulder, so that the manipulations are carried over the region of the brachial plexus. At first give much effleurage, also gentle kneadings, vibrations, and passive movements. Caution is needed if the nerve trunks are tender, in fact massage should not begin until this symptom has subsided somewhat. If spasm and contraction are present in the flexor muscles, only effleurage must be applied to them, whereas stimulating movements may be given to flaccid and weak extensors, viz., stimulating effleurage, petrissage, friction, and hacking. The treatment must continue for some weeks or even months. It must gradually increase in strength, and active and resistive movements should be eventually added.

After some weeks of rest, when there is improvement, the patient must train himself to perform small actions with the fingers and thumb.

Time for treatment, 20 to 40 minutes daily.

## PARALYSIS AGITANS : SHAKING PALSY, OR PARKINSON'S DISEASE

Paralysis agitans is a progressive nervous disease of advanced life. Tremors of the limbs occur, there is rigidity of muscles, and a loss of equilibrium when walking.

Some causes are: violent emotion, excessive fatigue, exposure to cold and wet, injuries involving nerves; but in many cases no cause can be discovered. No distinctive lesion has yet been found for this disease, but probably centres in the brain cortex are affected.

The tremors first appear occasionally in the hand, thumb, or foot. The fingers move as though rolling a pencil or crumbling bread. The movements gradually increase in frequency and spread to all the limbs. Eventually, the head, neck, and trunk become involved. Later rigidity of the muscles appears, and this may be accompanied by cramp-like pains. There is a characteristic attitude of the body, and the joints are held in a flexed position, hence contractions may occur. There is inability to maintain equilibrium when walking.

Other developments are: a sense of weariness of the affected muscles, and the patient eventually becomes irritable and fidgety. The speech is affected, and there is difficulty in swallowing. In rare cases the disease may be cured in the early stages, but as a rule it is incurable and lasts for many years.

*Treatment.* If massage is ordered, give a general strengthening treatment. Much effleurage of the limbs, to reduce the rigidity. Petrissage of the muscles to improve their nutrition. If contractions of the flexors are present, petrissage is given only to the extensors. The treatment should be of a soothing nature.

Breathing exercises should be taught and relaxation is important.

Mobility movements, carefully stretching any contractions as they occur.

Re-educate with easy active exercises, urging the patient to control the tremors.

Correct walking should be practised, and any double-sided exercises to help co-ordination should be given.

Frenkel's exercises are sometimes useful, but the patient must not be overtired, and frequent rests taken during the treatment.

For CHOREA OR ST. VITUS'S DANCE, see p. 287.

# CHAPTER XXXII

Headache—Fatigue and sleep—Insomnia—Relaxation—Suggestion.

## HEADACHE

PAIN in the head arises from many causes, and may be slight or severe according to circumstances. It is usually a symptom at some stage of most acute diseases, it occurs also during many chronic ones.

The condition will here be considered under the following headings :—

1. Headache as a result of congestion of the blood-vessels of the brain. This occurs during heart disease, emotional excitement, menstrual irregularities, disorders of the liver, bowels, and skin, the after-effects of drunkenness, anæmia, bodily fatigue, etc.

2. Headache caused by rheumatism, neuralgia, and neuritis. A severe variety of headache may be caused by rheumatic infiltrations in the muscles of the neck and scalp.

3. Megrim, migraine, or sick-headache. This form is periodical. It is induced by anæmia, general debility, and a nervous temperament. Some of the causes are : mental depression or excitement, bodily fatigue, anxiety, improper food, and breathing impure air. There are disturbances of vision and sensation, followed by intense pain, which may be limited to one side or part of the head. Cold hands and feet, nausea, and vomiting, and the pulse is feeble and slow. The attack generally lasts for a day, and occurs at intervals of weeks or months.

4. Headache is frequently due to some disability of the eyes. " Headache of ocular origin is usually frontal or orbital. It is rarely occipital or temporal, and hardly ever vertical " (*Griffith*).

Headache from this cause generally comes on in the late afternoon or evening, though it may also be first noticed in the morning. Various muscular contractions arise due to faults in the visual mechanism, and these cease when suitable correction has been achieved by spectacles.

*Treatment.* The cause of the headache must be discovered and removed as far as possible.

Massage may be ordered in cases of debility, anæmia, and disordered digestion, when a general strengthening treatment should be given, including much effleurage and muscle kneading, also abdominal treatment.

During the attacks of pain, local massage to the head and face may be beneficial. All manipulations should be of a slow and soothing nature (p. 46).

If there is congestion of the vessels of the brain, effleurage down the front of the neck and throat, *i.e.* over the jugular veins, may give relief.

For headache of rheumatic origin, the neck and shoulders should be treated daily for some weeks. Effleurage, kneading, deep friction, and tapôtement are applied to the muscles, followed by passive stretchings and active exercises. Lateral bending is often more limited than the other movements, and so needs special attention.

In fibrositis of the scalp massage must also be given daily, until the symptoms disappear. Thickenings should be treated firmly and persistently by friction. Headache of neuralgic origin requires soothing treatment. Stroking and vibrations over the course of the nerves, also careful nerve friction. The student is referred to Chapter V for details of head and face massage and to notes on vibrations, p. 17.

## FATIGUE AND SLEEP

Fatigue is a state of diminished functional fitness, of body or mind or both. Muscular fatigue is the result of muscular activity. The activity causes certain materials to be produced, and poured into the blood (see p. 20). The nerve endings in the muscles are also greatly influenced by the fatigue-producing substances, and the whole of the nervous system is affected.

It is well to define the difference between true and false fatigue.

Young, healthy people need not think of fatigue. They get healthily tired and like all young animals they " sleep it off." A false fatigue is seen when the subject is reluctant to work, or to start something uncongenial to them, or another may find it difficult to get up in the morning. In such cases an effort is necessary, and when made the fatigue is overcome. Others, however, may from general stress or strain and for a variety of reasons, often feel very tired, and are unable to rest. They must continue doing things, perhaps something which has to be finished in a given time, or others may be dependent on them for companionship and attention, and a variety of other instances might be given. Such people are suffering from real fatigue and need rest. This nervous tiredness can be much helped by physical means, combining rest with massage and graduated exercises.

Sleep is nature's great restorer from fatigue, and it is necessary for life.

" Sleep is the resting-time of consciousness, and as truly the resting-time of the central nervous system. Although the spinal cord does not become unconscious, for the excellent reason that it was never conscious, yet it would be a great mistake to suppose that it does not rest. It rests as completely as it can, compatibly with its maintaining some degree of tone in the muscles, and in the internal organs innervated by it " (*Harris*).

A proper amount of sleep is necessary to maintain the health of everyone. The amount varies according to age, and in the adult according to the health, temperament, and general environment of the individual.

An infant often sleeps for twenty hours out of the twenty-four. A child up to the age of ten should sleep at least twelve hours out of the twenty-four. From ten to fifteen years it should be ten to twelve hours. From fifteen to twenty-five years eight to nine hours. After this age it should not be less than seven hours. A nurse or physiotherapist often finds it necessary to inquire the amount of sleep a patient is taking. Such inquiries are specially necessary up to the age of twenty. Between the ages of fifteen and twenty, persons of both sexes are usually much occupied with study, work, etc.; but it must be remembered that the body and mind are still growing and developing, and the question of necessary rest and sleep is a very important one. Regular habits should be established in youth, and though no hard-and-fast rule can here be laid down, early hours for both retiring and rising are the best.

## INSOMNIA

Insomnia or sleeplessness may occur from a variety of causes, some of which are: painful conditions, excessive heat or cold, mental excitement or worry, indigestible food taken not long before bedtime, mental over-strain, bodily over-fatigue, nervous conditions (*e.g.* neurasthenia, gout, and various other acute and chronic diseases), drinking strong tea or coffee late at night, sleeping in new surroundings, etc.

People are known to suffer from complete insomnia, *i.e.* no sleep at all, night after night, when their condition is serious. Also from partial insomnia, when they may lie awake for hours, finally getting some sleep, or they may sleep the early part of the night, and then lie awake till morning. Such subjects often suffer from mental depression and gloomy forebodings.

*Treatment.* The cause must be found, and removed as far as possible. When massage is ordered, it is often well to give a general strengthening treatment in the early part of the day. Breathing exercises, and others for circulation. Massage of the extremities and the abdomen is often useful. Attention should be paid to any special symptoms. The patient should be treated again at night, when in bed, and ready for sleep. The room is darkened and the patient kept warm. No talking is allowed. General massage is often given, all stimulating manipulations and passive and active movements being omitted. Much effleurage and kneading are used. Special attention is given to back massage as follows: The patient lying prone. Much effleurage. Large kneadings with one hand down each side. Soothing friction, the fingers of both hands working together down each side of the spine. Vibrations, effleurage, and soothing strokings.

Time for back massage, 15 to 20 minutes.

The patient then turns over, the garments are rearranged as quietly as possible. Then soothing strokings are given over the head and face.

Time for stroking of head and face, 10 to 20 minutes.

## RELAXATION

In the treatment of many diseases, especially those of nervous origin, relaxation and rest are factors of great importance.

Patients are often wholely unaware that they are tensing their muscles. In some cases, *e.g.* during the recovery of an injury, the increased tensing often present is a way of guarding the injured part. This, however, must be overcome, and the physiotherapist has to teach the patient to feel whether or not he or she is tensing or relaxing the muscles.

Some years ago Miss Annie Payson Call devised a way by which the whole body could be placed in a condition of complete rest. Her methods are still in use.

The patient is taught to gradually relax all the muscles completely. The will power must be exercised to do this and the process is combined with a series of breathing exercises. The method is especially suited to those who are subjected to extreme nerve tension.

The patient must lie in an entirely restful position and first learn deep breathing. She must be persuaded to take an interest in the exercises. Long, slow deep breaths will change a condition of tension to one of calmness.

Then relaxation must be learnt and practised. It is not just " letting go and flopping."

The lower limbs are relaxed first.

The patient is asked to think of her leg in three parts: (*a*) hip to knee; (*b*) knee to ankle; (*c*) foot. Each part in turn should feel like a heavy sandbag. Eventually both legs lying apart should feel heavy. The physiotherapist lifts each limb from the couch slightly and allows it to drop again.

Deep breathing 4 to 6 times.

The same procedure then follows for the arms: (*a*) shoulder, (*b*) elbows, (*c*) wrist, must be relaxed. The physiotherapist may test the relaxation by placing a hand under the shoulder, lifting slightly and dropping again, then by lifting the whole arm, in the same way.

Deep breathing 4 to 6 times.

Next the patient thinks of the spine. The physiotherapist places her hands under the patient's back, lifts a little and tells the patient to let go. Shoulders and back must relax completely.

Deep breathing 4 to 6 times.

Next the patient thinks of her head as a heavy ball. The neck muscles must fully relax. The physiotherapist rolls the head gently from side to side, also lifts it and allows it to relax on to the pillow. The patient's eyes should be closed.

Deep breathing 4 to 6 times.

The abdominal muscles must also be relaxed, and while this is attempted the patient must never allow the throat muscles to become tense.

To relax the whole trunk as much as possible, the operator assists the patient to turn sideways (knees kept straight), and allows her to roll back to the starting position without effort.

As well as performing slow deep breathing as suggested, the patient should breathe freely and easily throughout.

In recent times these methods have been developed still further. Mrs. Guthrie Smith advises the use of her suspension slings which take the weight of the limbs, and suggests some form of relaxation as a preliminary to nearly all treatments. She also advises that the exercises should be combined with the application of warmth, massage, as well as the deep breathing already mentioned.

### SUGGESTION

Throughout all ages it is possible to trace in history the healing of disease by some means dependent upon psychic power.

In recent years there has been considerable revival of such methods undertaken scientifically by doctors specially in connection with nervous disorders.

So-called " Suggestion Treatment " is administered to certain patients, the aim being to " impress the mind with a new idea, or to strengthen a new impression that is too weak to be of any functional importance " (*Ash*). The great aim of the treatment is to implant within the patient's mind healthy ideas instead of morbid ones.

This treatment is undertaken by the medical man himself, or by someone who has made a special study of the subject.

Massage and sometimes exercises and electricity are useful adjuncts. The physiotherapist must work in conjunction with whoever administers the " suggestion," and often much patience and tact are required when dealing with patients who are undergoing this kind of treatment.

A further study of this subject is recommended to those who are brought into contact with it.

# CHAPTER XXXIII

## Physical treatment before and after childbirth.

PREGNANCY is a normal physiological process. The development of the fœtus within the uterus occupies 40 weeks or 9 calendar months. During this time the muscular walls of the uterus hypertrophy and new muscle fibres are formed. At the end of the 9 months the uterus extends to the costal margin and is 18 inches long. As the uterus increases in size, the skin and muscles of the abdominal walls necessarily become much stretched. When the fœtus is fully formed labour sets in. This consists of vigorous contractions of the uterine muscle, which continue until the child is born.

The physiotherapist does not undergo the training of a midwife, but at the present day she is called upon to help the expectant mother to prepare for her confinement. She must therefore know well the principles she may have to explain.

The doctor is generally consulted by the patient at stated intervals, but he often advises exercises which are taught by the physiotherapist.

The expectant mother therefore attends weekly classes (or she may be instructed individually) to learn what she is to expect, and what is expected of her. The physical exercises she learns serve as a preparation for the work she must do when her labour sets in.

The doctor will advise when the classes should start, but it is usually about the thirteenth to the sixteenth week. As far as possible those attending a class should be at the same stage of their pregnancy.

With regard to the mental attitude. It is necessary for the teacher to gain the mother's confidence, to answer simply any questions on points which should be known. To help the mother overcome all feeling of fear, and encourage her to lead a normal and happy life during her pregnancy.

Concerning the physical aspect. The mother must be taught deep breathing and relaxation. These are given in detail elsewhere in this book (pp. 147, 397). But there are a few other special points to consider during pregnancy.

Exercises must be learnt which will gently mobilise (by small movements) the joints of the pelvis, hips and lumbar spine. The postural muscles must be trained, for they must adapt themselves to take the increased weight which they have to support.

Therefore the muscles of the abdomen, spine and the pelvic floor must be exercised regularly, not only to maintain a good posture, but to prepare them for the important work they will have to do during labour.

Sometimes owing to the increase of weight the arches of the feet become weakened. Flat-foot exercises may then be practised (see p. 258).

The pregnant woman should lead a normal life, but she should rest daily for from 1 to 2 hours.

She is instructed to apply oil or skin food to the skin of her abdomen to prepare it for the stretching which must take place.

She also learns to prepare the breasts for lactation. (Special instruction given for this).

The following exercises are recommended :—

**Breathing** must be practised daily.

*Position.* Lying on floor or firm mattress, knees bent.

The expectant mother learns gradually to take long breaths in and out. The mouth is closed and the breathing done gently, the patient learning to control the depth and speed till she can breathe in and out for half a minute each way.

**Relaxation.** This must also be practised daily, and should be done in the prescribed rest time.

*Position.* Lying or side lying on a firm mattress, head supported on a pillow, and all joints slightly flexed.

The patient learns to bend and stretch a joint a little way and then to relax it. She performs the movements from toes to hips, and from fingers to shoulders.

The head may be gently rolled from side to side on the pillow, and the face muscles " screwed up " and " let go " again.

Finally, all parts of the body are relaxed together. Breathing is repeated.

The following should also be performed daily :—

Cross-leg or crook } lying. **Pelvic floor contraction and relaxation.**

The patient may be told to imagine she is preventing an action of the bowels by strongly drawing in the gluteii and the muscles around the anus.

At first she holds while counting five, and then relaxes. Later the holding is increased to 10 counts. The contractions may also be practised standing or sitting.

**Pelvic rocking.**

*Positions.* Crook lying, prone kneeling, sit kneeling and later standing.

(*a*) The patient contracts simultaneously the gluteal and lower abdominal muscles, and presses her back on to the floor.

(*b*) She then relaxes the abdomen, and at the same time arches the back.

These alternate contractions cause the pelvis to move. This can be recognised by feeling the anterior superior spines of the ilium. The spines come forward towards the head in (*a*), and downwards towards the feet in (*b*).

This constitutes pelvic rocking. The movement mobilises the joints of the pelvis, lower spine and hip-joints, and trains the muscles of the abdomen and pelvic floor, for the extra work they have to do. It also improves posture. It is of value in preventing backache.

*Crook Lying.* This is the first position used.

*Prone Kneeling.* The patient kneels on the floor, on hands and knees, keeping a right angle at shoulders, hips and knees. The pelvic rocking is done as before.

*Sit Kneeling.* The patient kneels in front of a chair and allows her hips to sink back on the heels. The knees well under the chair and her arms resting upon the seat. The rocking is done as before, alternately contracting and relaxing the muscles, the back being first pushed out and then hollowed.

**Leg Shortening.** Lying, right leg crook, left leg straight—Left leg shortening. Draw up at the hip as far as possible, then relax. Reverse position and repeat with right leg.

Further special exercises may be taught if required.

Any abnormal condition during the pregnancy must be referred to the doctor. Even then physical treatment may be ordered, especially if it is essential for the patient to rest.

Massage may be given :—

(*a*) If the patient is nervous, restless, or suffers from insomnia or neuralgia.

(*b*) For constipation and flatulence. Although abdominal massage is usually contra-indicated, there are some cases when it may be given up to the third month. It is safe till then, as the uterus has not risen into the abdomen.

(*c*) For varicose veins, or swelling of the feet and ankles.

During pregnancy the heart becomes hypertrophied and sometimes dilated. If symptoms of weakness appear, all the usual precautions for a heart patient must be taken.

In applying massage for any of the above conditions, the comfort of the patient must be studied in every way. The manipulations should be done slowly and gently, while tapôtement should be avoided. In cases where there is great stretching of the abdominal skin, gentle stroking movements with a lubricant give relief.

Gentle kneading and frictions in the lumbar region are found to be most comforting, but manipulations over the course of the femoral vessels should be avoided.

## DURING LABOUR

The nurse-midwife takes on the duties during the labour and lying-in period, though the physiotherapist may also be asked to attend during the labour. If she is present she assists her patient to carry out the instructions given during the months of preparation. By relaxing at the right time, by breathing suitably, and by assuming certain positions, the mother is greatly helped.

Further details of the system cannot be given here. Physiotherapists wishing to specialise in the work are referred to those who teach and write on the subject.

## POST-NATAL PHYSICAL TREATMENT

After the child is born, the uterus gradually decreases in size and weight until it returns to its normal position within the pelvis. This gradual reduction is called "involution." The process continues for 8 weeks, when the uterus assumes its normal size and weight.

Sub-involution is that condition when the uterus does not return to its normal size in the given time.

Involution is helped by lying face downwards during rest and relaxation. The position therefore should be adopted as part of the daily rest. Two pillows are placed under the pelvis to avoid the back hollowing and to prevent discomfort to the breasts. Another cushion is placed under the feet.

Before beginning exercises the bladder should be emptied. While still in bed the patient carries on deep breathing, also contractions of the pelvic floor and the abdominal muscles. These may be done every 2 hours.

A space will at first be felt between the two recti muscles which have been pushed apart, but the space gradually closes again, with correct muscle exercise. (Pelvic rocking is helpful.)

With the doctor's approval the mother begins to do exercises again as soon as possible after the baby is born.

The physiotherapist may refer to ward exercises on p. 140, but a graduated scheme is given.

For the first three days :—

Breathing as previously learnt.
Contractions of the pelvic floor and of the abdominal muscles.

On the fourth day add :—

Half lying, contractions of quadriceps.
Dorsi flexion of the feet with inversion.
Flexion of toes.
Gluteal contractions with internal rotation of hips.

On the fifth day add :—

Crook lying, elbow circling with head backwards pressing.

On the sixth day add :—

Leg shortening. Right and left (see p. 402).

On seventh and eighth days

Continue as before adding crook lying, head and shoulder raising.

On the ninth day :—

Prepare to get up.

By sitting on side of bed for :—

- Back uncurling.
- Trunk turning and arm flinging.
- Trunk rotation.
- Alternate knee extension.
- Lying, trunk side bending.
- Crook lying, swinging knees to right and arms to left. Then reverse.

These are continued for a time, but when the patient is allowed to get up she must practice correct posture and walking.

Flat foot exercises are added.

## The Breasts

Secretion of milk becomes active about three days or a little later after delivery.

The care of the breasts is undertaken by the nurse in attendance, and if an abnormal condition occurs, she carries out any necessary instructions.

If the milk is deficient the physiotherapist may be called upon. The breasts are then bathed with alternate very hot and very cold water for 2 or 3 minutes, the procedure being followed by brisk though gentle massage. Vibrations and gentle shaking movements should be included. A simple arm exercise may be added, giving active work to the pectoral muscles.

## BOOKS

*Revelation of Childbirth,* by Grantly Dick Read, M.D.
*Safe Childbirth,* by Dr. Kathleen Vaughan.
*Training for Childbirth,* by Minnie Randell, M.C.S.P.
*A Way to Natural Childbirth,* by Mrs. Helen Heardman, M.C.S.P.

# APPENDIX

## SPECIMEN QUESTIONS FROM EXAMINATION PAPERS OF THE CHARTERED SOCIETY OF PHYSIOTHERAPY

### 1943

1. Compare and contrast the muscle work, effects and uses of :—
   - (*a*) Wing-high-ride-sitting, trunk backwards-falling and raising.
   - (*b*) Wing-high-side-sitting, trunk back-bending.

2. Discuss the uses and contra-indications of active movements.

3. Describe the methods used in the rehabilitation of a stiff shoulder.

4. Contrast the massage manipulations used in treating :—
   - (*a*) Muscular wasting.
   - (*b*) Muscular spasm.

   What precautions should be observed in each case ?

5. Discuss some methods by which the pull of gravity may be eliminated and friction minimised, when giving exercises to a case recovering from flaccid paralysis of the deltoid.

6. Describe the causes, changes, symptoms and terminations of inflammation.

7. How would you proceed to examine a case of untreated congenital torticollis in a child of 12 years ? Give a suitable scheme of post-operative treatment.

8. What are the causes of sciatica ? How would you examine a patient suffering from this condition ? Give the treatment by physiotherapy of sub-acute or chronic sciatica.

9. Explain carefully how the straight abdominal muscles may be used :—
   - (*a*) Statically.
   - (*b*) In inner range.
   - (*c*) In outer range.

   Giving one exercise as an example in each case.

10. Write a concise note on :—
    - (*a*) Levers.
    - (*b*) Associated movement.
    - (*c*) Centre of gravity.

11. Give rules for the application of the various forms of bandaging.

12. How would you proceed to examine the foot of a middle-aged patient who complains of pain on walking ? What factors, local or otherwise, may contribute to the pain ?

13. Give a detailed treatment for a patient whose ulnar nerve has been sutured.

## 1944

14. Give the muscle work of :—
Standing, double arm raising sideways to the stretch position.

15. What physiological effects may be produced by massage of the abdominal organs ?

16. At what stage in the recovery of medical and surgical conditions is massage of value ? Give two examples and state what manipulations should be employed and why.

17. Explain methods by means of which general relaxation of the body and local relaxation of a limb may be obtained.

18. What is the value of the sling and pulley apparatus ? Give examples of how they are applied.

19. Give one method for immobilising a fracture of the shaft of the femur, and outline the treatment by means of massage and movement.

20. Briefly outline the treatment of a dropped wrist following a musculo-spiral nerve injury (radial nerve) during the period of splinting and until complete recovery.

21. What are the causes of Hallux Valgus ? Describe in detail the pre- and post-operative treatment of this condition.

22. Give in detail the method employed in the re-education of a recovering anterior tibial nerve injury, and state what type of splinting may be necessary.

23. Outline the treatment by physiotherapy for a case in which an operation has been performed for an empyema.

## 1945

24. Analyse the muscle work involved in riding a bicycle on a level road.

25. Why is the fundamental standing position a difficult one to hold ? Give a summary of the neuro-muscular factors involved in maintaining it.

26. Discuss the value of massage in relation to other methods of physiotherapy.

27. Give reasons justifying the use of physiotherapy after child-birth. What precautions should be observed ?

28. Draw up a progressive course of treatment for a man recovering from an operation for inguinal hernia.

29. Give a short table of exercises suitable for post-operative ward cases. Explain the value of ward classes and indicate how the difficulties in their application may be overcome.

30. Give a brief description of the following conditions, and outline the principles on which the treatment is based :—

(*a*) Talipes equino-varus.
(*b*) Traumatic synovitis.

31. Give the principles of treatment of a case of mitral stenosis, after a failure of compensation and illustrate by a detailed treatment :—

(*a*) In bed in the early stages.

(*b*) In the gymnasium just before discharge.

32. Give the main muscle work employed in walking up and down stairs.

33. What is understood by the term "paraplegia"? and how may this condition arise? Briefly outline the method used in the rehabilitation of such a case following spinal injury.

34. What are the guiding principles in the treatment of postural scoliosis? Apply these principles in a table for a schoolgirl of 15.

35. Write a clear account of the process of repair of a fractured bone. Why is a clear understanding of this process essential for the correct application of physiotherapy?

### 1946

36. What manipulations are included under the heading of Pétrissage; and what are their particular effects and uses?

37. Give the broad principles upon which the treatment of anterior poliomyelitis is based and apply them in a case of paresis of the quadriceps.

38. What massage manipulations would prove most effective in relieving a condition of habitual constipation? Give reasons for your selection.

39. Suggest manipulations suitable for:—
    (*a*) Dislodging mucus in chronic bronchitis.
    (*b*) Dispersing œdema of traumatic origin.

40. Describe the treatment by massage and exercises of a case of right-sided hemiplegia in an elderly woman.

41. Outline the technique employed in:—
    (*a*) Removing elastoplast bandage from a limb.
    (*b*) Applying elastoplast bandage to control œdema.
    (*c*) Removing a soiled dressing and applying a sterile dry dressing.

42. Give the causes, pathological changes and physical signs of rickets.

43. Describe the muscle work involved in neck-rest-prone lying, head and shoulder raising, with double leg raising. Give indications and contra-indications for the use of this exercise.

44. What methods may be employed to add progressive resistance to a movement? Apply this knowledge to the re-education of weak ham-strings.

45. A patient of 25 has had an excision of the patella after a comminuted fracture. Describe the treatment by means of massage and exercises from the day of operation until discharge.

46. Analyse the muscle work of stride-standing, alternate trunk rotation with double arm swinging. Give the effects and uses of this exercise.

47. A young man of 25 is suffering from bronchiectasis of the right lower lobe, and is to undergo an operation for lobectomy in 3 weeks' time. Write a brief but clear account of the pre- and post-operative physiotherapy.

48. A patient with severed extensor tendons at the wrist,

which have been sutured two days previously, is ordered physiotherapy.. What form of immobilisation might be employed. Outline the treatment.

## 1947

49. What treatment would be suitable for a boy of 10 years suffering from bronchial asthma ?

50. Describe the signs and symptoms of a case of Erb's palsy. Outline a suitable plan of treatment.

51. Describe the treatment in bed by massage and movements of a girl of 16 years whose right anterior tibial and gluteal muscles have been affected by anterior poliomyelitis.

52. Give the technique to be observed in treating :—
    (*a*) Pressure points in a bedridden patient.
    (*b*) In renewing a dressing of an infected wound.

53. On what points would it be decided that a child was suffering from postural valgus feet ? Explain the principles of treatment.

54. What exercises would be employed in the treatment of a fractured second lumbar vertebra from the date of injury to the time of discharge.

55. What is understood by tennis elbow ? Give the signs and symptoms and principles of treatment.

56. How may a fracture involving the lower third of both tibia and fibula be immobilised ? What physiotherapy may be given :—
    (*a*) During the period of immobilisation ?
    (*b*) After immobilisation ?

## 1948

57. Describe the methods of application of massage manipulations used for the treatment of :—
    (*a*) Fibrositis.
    (*b*) Œdema.
    (*c*) Scar tissue.

58. Give a reasoned account of the signs and symptoms which may be encountered in a woman of 45 years suffering from a cervical rib.

59. Describe the treatment which may be given for a patient of 25 years suffering from bronchiectasis for which operative treatment is not considered.

60. Analyse the muscle work involved in walking upstairs.

61. Differentiate between concentric, eccentric and static muscle work, and state clearly when each is indicated.

62. Describe the principles of re-education of posture and illustrate the answer by reference to the treatment of a child of seven years after removal of adenoids.

# GLOSSARY

*Abrasion.* An excoriation of the skin or mucous membrane.
*Adolescence.* Period between puberty and maturity.
*Angina Pectoris.* Pain and oppression about the heart.
*Ankylosis.* Union of bones forming a joint.
*Anorexia.* Dislike to food.
*Aphasia.* Loss of speech.
*Aphonia.* Loss of voice.
*Arterio-sclerosis.* A hardening of the walls of arteries.
*Arthrodesis.* The surgical fixation of a joint.
*Ascites.* Dropsy of the abdomen.
*Atony.* A want of tone. Debility.
*Atrophy.* Wasting of a part.
*Axis-cylinder.* The central core of a nerve-fibre.

*Centrifugal.* Moving towards a centre.
*Centripetal.* Moving away from a centre.
*Clinic.* Bedside instruction.
*Clonic spasm.* Spasms with alternate relaxations.
*Colic.* A term used to describe pain in the abdomen. It is generally due to violent and irregular contractions of unstriped muscular tissue. The pains are paroxysmal and of a sharp and cutting nature. They may have origin in the stomach, intestines, gall-bladder, bile-ducts, kidneys, and pancreas. Colic is therefore a symptom of many diseases.
*Congenital.* Existing from birth.
*Contra-indications.* Anything forbidding a line of treatment.
*Cyanosis.* Blueness of the skin from non-oxidation of the blood.

*Defæcation.* Evacuation of the bowels.
*Diagnosis.* Recognition of disease from its symptoms.
*Diaphysis.* The shaft of a long bone.
*Diathesis.* A constitutional predisposition to disease.
*Distal.* Distant. D. extremity of a limb—that part which is farthest from the trunk.
*Diuresis.* An excessive secretion of urine.
*Dyspnœa.* Difficult or laboured breathing.

*Effusion.* Extravasation of fluid into the body-tissues or cavities.
*Emphysema.* Distension of the tissues with air.

*Empyema.* Pus in the pleural cavity.
*Epiphysis.* A process of bone attached to another by cartilage.
*Eructations.* Belching.
*Etiology.* The science of the cause of disease.
*Excoriation.* A stripping or wearing of the skin.
*Extravasation.* A passing of fluid into the tissues.
*Exudation.* A morbid oozing out of fluids.

*Fæces.* Excrement. Matter excreted from the bowels.

*Hæmatemesis.* Vomiting blood.
*Hæmoptysis.* Hæmorrhage from larynx, trachea, or lungs.
*Hernia.* The protrusion of an organ from its normal position.
*Hyperemia.* Excess of blood in a part.
*Hyperesthesia.* Increased sensibility of the skin.
*Hypertrophy.* Abnormal increase in the size of a part or an organ

*Induration.* Hardening.
*Inhibitory.* Having the power to restrain.
*Intrinsic muscles of the hand.* Those which are attached only to the bones of the hand.

*Lesion.* Structural tissue-change from injury or disease.

*Malingering.* Feigning injury or illness.
*Micturition.* The act of expelling the contents of the bladder.
*Mucus.* The viscid, watery secretion of mucous membrane.
*Myosotis.* Inflammation of muscle tissue.

*Œdema.* Swelling caused by effusion into the cellular tissues.
*Osteo-myelitis.* Inflammation of the medulla of bone.

*Paresis.* Slight paralysis.
*Parturition.* The act of giving birth to young.
*Peri-metritis.* Inflammation around the uterus.
*Peri-neuritis.* Inflammation of the sheath of a nerve.
*Periphery.* Circumference or outer surface.
*Physio-therapy.* The treatment of disease by physical means.
*Peristalsis.* The worm-like contractions of the alimentary canal, by which its contents are propelled onwards.
*Precordial.* Pertaining to the area of the chest over-lying the heart.
*Prognosis.* Prediction of course and end of a disease.
*Prolapse.* The falling down of a part.

*Prone.* Face downwards.

*Prophylaxis.* The prevention of a disease.

*Proximal.* The opposite to distal. P. extremity of a limb, that part which is nearest to the trunk.

*Ptosis.* Abnormal depression of a part, or a falling down.

*Puerperal.* Pertaining to child-bearing.

*Purulent.* Having the character of pus.

*Pyogenic.* Developing or secreting pus.

*Septic.* Pertaining to the decomposition of matter.

*Sequelæ.* Morbid conditions following a disease.

*Spastic.* Pertaining to spasm, rigid.

*Strangulated hernia.* A portion of intestine so tightly constricted as to interfere with its return to position, and with the passage of fæces.

*Supine.* Lying on the back.

*Therapeutics, Therapy.* The branch of medical science concerned with the application of remedies, and the healing of disease.

*Tonic spasm.* A continued rigid muscular contraction.

*Toxic.* Pertaining to poisoning.

*Traumatic.* Pertaining to an injury.

*Vertigo.* Giddiness.

*Viscera.* Plural of viscus. The organs situated in one of the cavities of the body.

*Weir-Mitchell.* An American doctor who in the late nineteenth century arranged a system by which a weakened and debilitated person was restored to health by means of continuous rest, excessive feeding and regular massage. The method is now rarely used.

# BIBLIOGRAPHY

*Massage and Medical Gymnastics*, by Dr. Emil Kleen, translated by Mina Dobbie, M.B., B.Ch. Second Edition, 1920. (J. & A. Churchill.)

*Physical Treatment by Movement, Manipulation and Massage*, by James Mennell, M.D. Fifth Edition, 1945. (J. & A. Churchill.)

*Backache*, by James Mennell, M.D. Second Edition, 1935. (J. & A. Churchill.)

*Massage, Manipulation and Local Anæsthesia*, by James Cyriax, M.D. 1942. (Hamish Hamilton.)

*Deep Massage and Manipulation*, by James Cyriax, M.D. 1944. (Hamish Hamilton.)

*Action of Muscles: Including Muscle Rest and Muscle Re-education*, by Sir Colin Mackenzie, F.R.C.S. Second Edition, 1940. (H. K. Lewis.)

*Fractures and Joint Injuries*, by R. Watson-Jones, F.R.C.S. Third Edition, 1943. (E. & S. Livingstone.)

*Massage and Remedial Exercises*, by Noel M. Tidy, M.C.S.P. Seventh Edition, 1947. (John Wright & Son.)

*Manual of Massage and Movements*, by Edith M. Prosser, M.C.S.P. Second Edition, 1941. (Faber and Faber.)

*Massage and Medical Gymnastics*, by Mary Lace, M.C.S.P. Third Edition, 1945. (J. & A. Churchill.)

*Rehabilitation, Re-education and Remedial Exercises*, by Olive Guthrie-Smith, M.B.E., F.C.S.P. 1943. (Baillière, Tindall & Cox.)

*The Rehabilitation of the Injured*, by John H. C. Colson, M.C.S.P., M.A.O.T.
Volume I. *Occupational Therapy*. 1944.
Volume II. *Remedial Gymnastics*. 1947. (Cassell.)

*A Way of Life for the Handicapped Child. A New Approach to Cerebral Palsy*, by Eirene Collis. 1947. (Faber and Faber.)

*A Textbook of Orthopædic Nursing*, by Evelyn Pearce, S.R.N., M.C.S.P. Third Edition, 1943. (Faber and Faber.)

*Remedial Exercises for Certain Diseases of the Heart and Lungs*, by Hester S. Angove, F.C.S.P. Second Edition, 1948. (Faber and Faber.)

*The Physical Treatment of Anterior Poliomyelitis*, by Diana Kidd, 1944. (Faber and Faber.)

*Natural Childbirth*, by Grantly Dick Read, M.D. 1933. (Heinemann.)

*Revelation of Childbirth. The Principles and Practice of Natural Childbirth,* by Grantly Dick Read, M.D. 1943. (Heinemann.)

*Safe Childbirth,* by Kathleen Vaughan, M.B. 1937. (Baillière, Tindall and Cox.)

*Training for Childbirth from a Mother's Point of View,* by Minnie Randell, O.B.E., S.R.N., F.C.S.P. Fourth Edition. 1948. (J. & A. Churchill.)

*A Way to Natural Childbirth,* by Helen Heardman, F.C.S.P. 1948. (E. and S. Livingstone.)

*The Theory of Occupational Therapy,* by Norah A. Haworth, M.A., M.R.C.S. and E. M. Macdonald. 1940. (Baillière, Tindall & Cox.)

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